In the Supreme Court of the United States

OCTOBER TERM, 1976

No. 76-1442

A. G. SPALDING & BROS., INC., and
QUESTOR CORPORATION,
PETITIONERS,

v.

PAUL SULLIVAN SPORTS, INC.,
RESPONDENT.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FIRST CIRCUIT

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PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FIRST CIRCUIT

The petitioner, A. G. Spalding & Bros., Inc., division of Questor Corporation, respectfully prays that a writ of certiorari issue to review the judgment of the United States Court of Appeals for the First Circuit entered on January 19, 1977.

Opinions Below

The opinions of the District Court and the Court of Appeals appear in the Appendix hereto respectively at A. 32 and A. 11.

Jurisdiction

The judgment of the Court of Appeals was rendered on January 19, 1977. This petition for certiorari was filed within 90 days of that date. This Court's jurisdiction is invoked under 28 U.S.C. §1254(1).

Questions Presented

(1) Whether the same standard of comparison must be employed for judging validity as for judging infringement?

(2) Whether the validity of a patent on a tubular metal tennis racket frame can be predicated on the thickness of the walls of the extrusion when all of the experts agreed, and the Court found (when judging infringement), that to change the thickness of the walls was mere "straightforward engineering"?

Statutory Provisions Involved

§ 102. *Conditions of patentability; novelty and loss of right to patent*

A person shall be entitled to a patent unless—

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

§ 103. *Conditions for patentability; non-obvious subject matter*

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Statement of the Case

I. General

Petitioner comes before the Court seeking a review of the decision of the United States Court of Appeals for the First Circuit (A. 11) affirming a decision of the District Court (A. 32), adjudging patent No. 3625512 (A. 65) valid and infringed and awarding the plaintiff $669,120.00 based on doubling the damage calculated at a rate of 5½% of Petitioner's sales.

II. Petitioner's Contention in a Nutshell

The lower Courts have taken an inconsistent stand between their findings of infringement and their holdings of validity. Thus, in order to find infringement, the lower Courts found, as a fact, that certain differences between the accused devices and the patent are "straightforward engineering" and can be ignored for purposes of infringement, but when it came to validity, those same differences were held to have patentable significance. It is settled law in other circuits, however, that the same standard must be

applied when deciding infringement as validity; *Fife Manufacturing Co.* v. *Stanford Engineering Co.*, 299 F.2d 223, 226 (7th Cir. 1962); *George Lerner and Julius Ellman* v. *Child Guidance Products, Inc. and Questor Corporation*, — F.2d —, (C.A. 2, No. 76-7041, decided 12/22/76).[1] A decision of this Court is needed to resolve this conflict between circuits. Moreover, an error of major economic significance has been made warranting correction by this Court.

III. The Patent in Suit

The patent in suit relates to tennis rackets and more particularly to a metal framed racket sold commercially by Spalding under the trademark "Smasher".

In recent years, tennis has been flourishing under what has become known as the "tennis boom". The racket of the patent in suit is a child of that boom.

Of the many things which can affect the playability and saleability of a tennis racket such as the strings, the way the strings are supported, the shape of the head, the throat, the size, the weight, the balance between head and handle, the resiliency of the frame, the grip, etc., *none* is involved in this case. The patent in suit concentrates on only one thing, i.e. the internal *cross-section of the frame.* More particularly, with respect to that cross-section, the claims in issue (A. 69) focus on certain *relative dimensions.* The cross-section upon which the patent in suit was based is a double hollow tube having relative dimensions as follows:

(A. 97)

[1] This opinion will be published in the U.S.P.Q. Advanced Sheets, Vol. 193 in April or May of 1977.

IV. The Lack of Evidence Showing That the Relative Dimensions Are Important

There was no evidence showing that any of the relative dimensions of the patented cross-section was responsible for any particular desirable result. Only one extruded racket was made by the patentee before he filed his patent. No tests were *ever* run by the patentee (even during the law suit) to show that different dimensions would not produce as good a result (A. 93), or that there was anything critical about the dimensions shown.

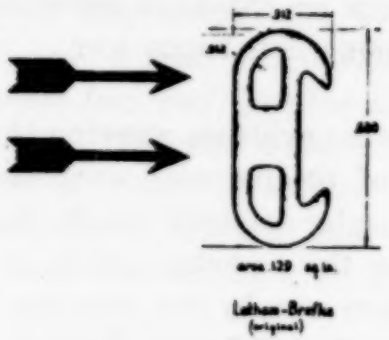
In fact, the evidence showed that the actual dimensions of the patent in suit did not make a racket which could stand up in the field (A. 86-88). The original dimensions had to be substantially modified before it could be sold (A. 86-92). Thus, the claimed dimensions were not and cannot be regarded as critical.

V. In Addition, the Lower Courts Found That Changing the Relative Dimensions Amounted to Mere "Straightforward Engineering"

The Trial Court found, as a fact, that changing the relative dimensions of the cross-section is merely "straightforward engineering", and that merely to remove material from the inside of a hollow extrusion so as to enlarge the hollows or even to create a new hollow in order to lighten the frame was "straightforward engineering" (A. 52). In fact, the conclusion of infringement was based on this specific finding.

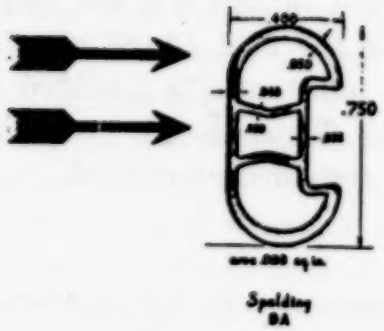
Thus, the difference between the

thick tube walls
and the
solid mid-section
of the
patent in suit



and

the thin tube walls
and
hollow mid-section
of the
accused device



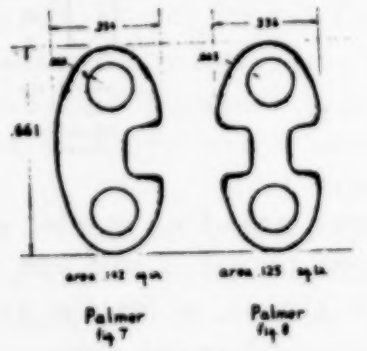
was held to be merely "straightforward engineering", (A. 24, 52) and "not much of a step in 1967" (A. 84).

VI. The Prior Art

Prior to the patent in suit, a tubular steel racket, i.e. the Wilson T-2000 (herein referred to as the "LaCoste") was very popular. It employed a bi-hollow frame having the following cross section:

(A. 98)

Another prior art bi-hollow metal tennis racket frame (herein referred to as "Palmer") was of extruded aluminum and had a choice of two cross-sections as follows:

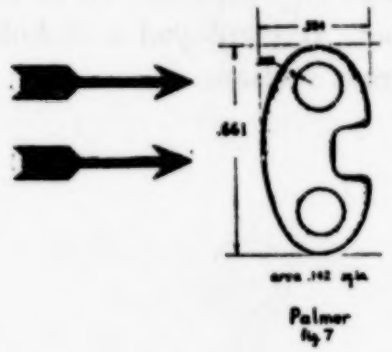


(A. 97)

VII. The Difference Between Palmer and the Patent in Suit

The difference between Palmer and the patent in suit is that

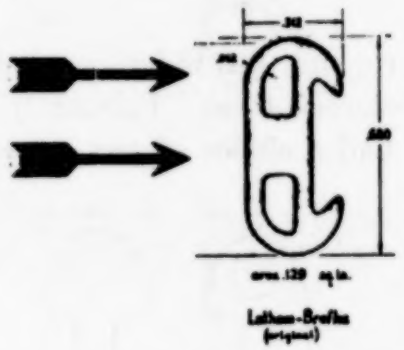
Palmer's
tube walls are thicker
and his
mid-section is thicker



Palmer
fig 7

whereas by comparison, the patent in suit has

thinner tube walls
and a
thinner mid-section



These differences, however, are of no greater degree than the differences between the patent in suit and the accused device (compare page 6 above), which the lower Courts found to be merely "straightforward engineering".

Argument

In finding infringement the lower Courts established the factual standard that merely changing relative dimensions, such as changing the wall thickneses of tubular extrusions, and making parts thereof hollow which were previously solid, is straightforward engineering, and that such differences can be ignored for purposes of infringement. This finding was well supported by the expert testimony (A. 84) and since it was not "clearly erroneous", it can be taken as proven. By applying this same standard to the prior art reference Palmer, one finds that the only differences between Palmer and the patent in suit are mere differences in relative dimensions, such as thickness of walls or the hollowness of tubes, of the same order as those held to be *insignificant* for purposes of judging infringement. In the absence of a showing that any specific dimension of the extrusion of the patent in suit provides a new or different result*, these findings of fact of the lower Courts lead inevitably to a conclusion of invalidity because the same standard of comparison must be applied for validity as for infringement; *Fife Manufacturing Co.* v. *Stanford Engineering Co.*, supra; *George Lerner and Julius Ellman* v. *Child Guidance Products, Inc. et al.*, supra. The fact that the Spalding "Smasher" enjoyed commerical success cannot validate an otherwise invalid patent; *Sakraida* v. *Ag Pro, Inc.* ___ U.S. ___; 189 USPQ 449 (1976). Moreover, in order for commercial success to be relevant, there must be a showing that it was due to the intrinsic merit of the invention rather than to a fad or temporary style; *Ripple Sole Corp.* v. *Am. Biltrite Rubber Co., Inc.*, 302 F.2d 2, 133 USPQ 335 (C.A. 1, 1962).

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* No such showing was made, see para. IV, p. 5, above.

Reasons for Granting the Writ

(1) The decision below is in conflict with the decisions of the 2nd and 7th Circuits for failing to apply the same standard of comparison when judging infringement as when judging validity. A decision of this Court is needed to resolve the confusion of the law created by the decision below.

(2) Serious errors of law have been made by the Court below, and the award of $669,120.00 based on it is a major consequence worthy of the attention of this Court.

Conclusion

Therefore the petitioner respectfully prays that the Supreme Court grant this petition to review the decision of the United States Court of Appeals for the First Circuit.

Respectfully submitted,

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[NOT FOR PUBLICATION]

APPENDIX

United States Court of Appeals
For the First Circuit

No. 76-1338

PAUL SULLIVAN SPORTS, INC.,
PLAINTIFF, APPELLEE,
v.
A. G. SPALDING & BROS., INC., et al.,
DEFENDANTS, APPELLANTS.

APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS
[Hon. JOSEPH L. TAURO, *U.S. District Judge*]

Before COFFIN, *Chief Judge*, CAMPBELL, *Circuit Judge*,
and GIGNOUX,* *District Judge*.

Robert B. Russell, with whom *Henry C. Nields, Donald R. Bahr*, and *David A. Tucker* were on brief, for appellants.
John A. Lahive, Jr., with whom *Herbert P. Kenway, Peter J. Manus*, and *Kenway & Jenney* were on brief, for appellee.

January 19, 1977

COFFIN, *Chief Judge*. This is an appeal from a decision of the district court holding valid and infringed U.S. Patent No. 3,625,512, filed January 26, 1968, and issued on December 1, 1971 to Latham and Brefka. Plaintiff-appellee, Paul Sullivan Sports, Inc., a sports clothing manufacturer, is owner by assignment of the patent. Defendant is A. G. Spalding & Bros., Inc. (Spalding), a sporting goods manu-

* Of the District of Maine, sitting by designation.

facturer and a division of the Questor Corporation. The subject matter of the patent is the cross-section configuration of a tubular one piece metal tennis racket frame constituting the handle, throat, and head of a racket.

Metal rackets had appeared on the market in the 1920's but had largely disappeared in the early 1930's. Spalding, however, continued to maintain an experimental engineering staff of 10 to 15 people in its Chicopee, Massachusetts plant, and to try to develop a metal tennis racket from the 'thirties to the late 'sixties. The efforts included bending steel rods, boring rod stock, using cold drawn tubing, aluminum, and plastic. A wide variety of shapes were considered and rejected. In the late 'sixties Spalding rejected a racket frame patented by one Lacoste, the cross section (referred to as a "squashed tube") resembling a round tube pressed together across the middle to form something like an hour glass figure or a figure eight. A competitor, Wilson Sporting Goods, acquired the Lacoste patent and successfully entered the market with the T-2000 model based on the patent. This racket may have largely revived the metal racket market.

At the time the T-2000 was making its appearance, in August of 1967, plaintiff's president, Paul Sullivan, then four years out of college and a nationally ranked tennis player, and Peter Latham, an engineer, while conversing at a tennis tournament, talked about the T-2000 and its "trampoline" or vibrating reaction when it hit the ball. Latham and his firm (LBA) looked into materials, made some calculations, and, as a result, Sullivan approached Spalding to underwrite the development of a new metal racket. When Spalding refused, LBA, after experimenting with I beam and other solid cross-section concepts, developed, by December, 1967, a racket frame of aluminum, the weight having been diminished by forming, through extrusion, two somewhat irregular channels or hollows through

the length of the frame. Sullivan, using the racket, found it had superior playing characteristics. By January, 1968, Spalding evinced new interest in the racket. Latham and his associate, Brefka, had filed their patent application, and serious meetings were held with Spalding. At one of these the racket was subjected to an arduous "whack test" —the racket fixed to an arm which repeatedly hit balls— and showed a distinct and permanent bending or "set" at the end. Nevertheless, Spalding, apparently thinking that the concept held promise, entered into a license agreement with Sullivan in mid-February, 1968.[1]

Spalding made some modifications and by May, 1968, was promoting and selling the "Smasher", adapted from the Sullivan-Latham model, noting on the racket that the patent was pending and naming both Sullivan and LBA. Sales were 8,500 in 1968 and 50,000 in 1969. Some noted sports figures used it effectively, with attendant newspaper publicity, although various defects were reported. By early 1970 other companies were marketing copies and Sullivan's patent application had been rejected by the Patent Office. Spalding's patent attorney, Bahr, taking a dim view of the possibility of the Latham-Brefka patent being allowed with any significant breadth, advised Spalding to terminate the license under a clause protecting Spalding from unlicensed competition. He also reasoned that even if a patent covering the Smasher should finally issue, Spalding would be running little risk since the saving in royalties would cover either efforts to "re-design around" the patent or the costs of litigation challenging the patent. Spalding accepted its attorney's advice and ended the license, but it continued to

---

[1] It was an exclusive agreement covering both foreign and domestic rights. It set a royalty of 8.3% for all frames sold at a price over $15.00. The agreement had a termination clause permitting Spalding to end the agreement by giving six months' notice on any anniversary date. The agreement could also be terminated if the licensor failed to stop infringing competition.

produce the Smasher and, in addition, developed a racket frame containing three, rather than two, internal hollows in the extended tube.

After some efforts to reinstate a licensing agreement, Sullivan sued in November, 1972, seeking injunctive relief, an accounting and reasonable royalties, treble damages, attorney's fees, and costs. After discovery and trial on liability, the district court held for Sullivan on both the validity and infringement issues. A hearing on damages was held by a special master. His recommendation that damages be calculated at a reasonable royalty rate of 5.5 per cent and that damages be doubled were accepted by the court in the amount of $592,528 plus interest. Plaintiff's request for counsel fees was denied. Spalding appealed.

The Patent in Suit

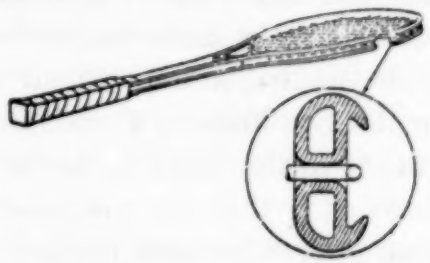
This is not a difficult patent case in the sense of presenting a problem in an art or science which strains the comprehension of the layman. But it does pose a difficult problem in communication by verbal description. We reproduce in the margin the three claims of the Latham-Brefka patent at issue but do not expect the reader to be tremendously enlightened.[2] Counsel on both sides have also felt the

[2] "1. A game racket frame for stringing comprising,
an aluminum extrusion that is a unitary structure having two seamless hollow tubes formed with an interconnecting web of material thickness that is more than twice the wall thickness of each tube,
the cross-sectional dimension of said extrusion perpendicular to the stringing plane being greater than the dimension of the extrusion parallel to the stringing plane,
the exterior cross-sectional dimension of each of said tubes being significantly greater in the direction perpendicular to the stringing plane measured from the center of said extrusion to each end [than] in the direction parallel to the stringing plane,
the exterior cross-sectional dimension of each of said tubes being significantly greater in the direction perpendicular to the stringing plane measured from the center of said extrusion to each end [than] in the direction parallel to the stringing plane measured across said interconnecting web from one side of the extrusion to the other,
each of said tubes having an internal hollow with a shape substantially corresponding to the exterior shape of the tube with the said wall thickness thus being formed therebetween being substantially constant,
the dimensions of said internal hollows perpendicular and parallel to said stringing plane being greater than said tube wall thickness,
said extrusion being formed into a racket shape having a curved head frame, throat and handle extension.

"2. A game racket frame for stringing in accordance with claim 1 wherein the separation between the internal hollows of said tubes is greater than the wall thickness of the first of said tubes added to the wall thickness of the second of said tubes,
and said interconnecting web is formed with rounded openings along at least a predetermined intermediate portion of its length corresponding to said curved head frame for receiving game racket strings with the separation between adjacent ones of said openings corresponding to the separation between adjacent strings when said frame is strung.

"4. A game racket extrusion for stringing in accordance with claim 1 wherein said extrusion is formed with lips extending outwardly of the racket shape from portions of each of said tubes nearer to the ends of said extrusion away from said stringing plane than to said stringing plane."

inadequacy of words alone and have resorted to illustrations. We therefore reproduce a picture of what the Latham-Brefka patent is talking about.



In language we hope is understandable to the general reader, the essential claims are: (1) that the basic racket frame (except for the throat piece) is one piece of aluminum, with two internal hollows in it throughout (shown by the irregular white spaces in the cross-section; the horizontal white space designates a hole for a racket string); (2) that between the two hollows there is a "web" wider (from left to right) than the width of the two cross-hatched sides of the hollows; (3) that the up-and-down dimension of the cross-section is greater than the left-right; (4) that the up-and-down dimension of the top and bottom halves is greater than the left-right dimension across the "web"; (5) that the hollows (the top and bottom white spaces) substantially follow the contours of the outside surface and have substantially the same wall thickness; (6) that the two hollows be taller and wider than the surrounding walls.[3]

We are apparently dealing with equipment which defies precisely demonstrable relationships. Our reading of the record reveals several principles. First, metal is strong. Second, a frame made of one piece of metal is the strongest construction. Third, a racket, while it should be strong, should also be light. Lightness in a metal construction can be achieved by removing weight from the interior. Fourth, to the extent that weight, within some indefinable limits, can be distributed to points remote from the center of the cross-section, there will be greater strength and resistance to torsion or the twisting effect of a ball being hit off center. Latham and Brefka did not conduct exhaustive tests or produce charts showing the precise ratios or dimensions giving the optimum mix of strength, lightness, and stiffness

[3] We omit a paraphrase of claim 2, which allows for racket string holes in the frame, and of claim 4, which describes "lips" or protrusions to help protect the strings and possibly to enclose a protective strip over the strings.

making up the perfect racket. All that can be said is that the engineer Latham and the tennis expert Sullivan came up with a construction and a concept that produced a metal tennis racket that worked very well. We observe that appellant does not attack the generalized and imprecise ratios for lack of scientific support. It accepts the teachings but argues that they were either anticipated or obvious, or should be so narrowly construed that its products do not infringe.

The Robinson Patent

Appellant attacks the Latham-Brefka patent as obvious, relying on a prior patent which maintained a very low profile in the proceedings below. What now occupies stage center, the Robinson patent, No. 1,930,285, issued October 10, 1933, hovered mostly in the wings at trial, coming on-stage for a few lines. The procedural history is muddy. It was not included in the pretrial notice of patents that Spalding would rely on 35 U.S.C. § 282. But it was included in an exhibit and mentioned in the pretrial brief. And plaintiff filed no objection. At trial, when objected to, appellant minimized its importance and urged its admission as cumulative and simply to rebut a contention made against the Lacoste patent, No. 3086777, which has dropped out of this appeal. But the court finally admitted it, as far as we can see, without limitation. It is clear that it did not bulk large in the district court's mind. In a rather extensive opinion, Robinson received thirteen lines, some of which wrongly described its teaching as applying to ski poles, screen door panels, and camera tripods. The court observed that the patent did not reach a seamless hollow tube with a web of more than twice the wall thickness and that no viable tennis racket emerged from the patent. So small a role did Robinson play below that we do not seriously fault the court.

But we do think the issue has been preserved, if lamely.[4] In a way it is a classic issue, and it demonstrates the congenital difficulty facing courts in deciding issues of retrospective obviousness.[5] The present almost always springs from seeds sown in the past. If one reduces the inspiration of the present to its conceptual essentials, he can point to a precursor in the past. The Robinson patent, issued 43 years ago, is a compendious patent showing a wide variety of uses for a single basic idea. The thrust of the Robinson patent is to permit simultaneous heat treatment and brazing of a plurality of metal structures. For example, to avoid the expense of drawn seamless tubing while still creating a strong tube, Robinson suggests that three concentric tubes be heat treated together. The middle tube is to be made of some fusing material that will fuse at about the temperature needed to treat the outer tubes. Out of fifty drawings illustrating this principle, two were devoted to tennis rackets, one showing the throat of a racket with a superimposed outside steel support and the other showing a "squashed tube" similar to the Lacoste patent, with one exception; where the sides of the tube are pressed together, Robinson inserts a fusing strip. This strip fuses the sides of the tubes when the tube is heat treated. No dimensions or ratios or instructions as to such are given in the text or drawing.

At trial Robinson's relevance was to show that Lacoste's squashed tube, figure eight or hour glass figure, could avoid the weakness of one side moving independently of the other

[4] Moreover, since this Robinson patent was not cited to the Patent Office, we approach our analysis without giving weight to the usual presumption of validity. *Cf. Forbro Design Corp.* v. *Raytheon Co.*, 532 F.2d 758, 762 (1st Cir. 1976).

[5] Appellant has also argued that Robinson anticipates the patent in suit. Sufficient differences between the two will be discussed, *infra*, to make it apparent that, however close the issue as to obviousness may be, Robinson did not specifically teach the essential instructions of Latham-Brefka.

by borrowing the concept of Robinson's fusing strip, which would make the entire structure as if unitary (much as pieces of wood can be joined by mortise and tenon), and which would also satisfy the claim of the patent in suit that the width of the web between the hollows be greater than two wall thicknesses. Admittedly the fusing strip would create a greater width in the web, if only microscopically so. But, as appellant's witness testified, the fusing strip might not be so strong as the walls it fused and in any event a seam would have been produced.

On appeal much of appellant's argument is based on Robinson.[6] In addition to arguing that the fusing strip made the construction a unitary one, and that the width of the web was somewhat in excess of two wall widths, appellant now adds that its expert's measurements of Robinson's schematic cross-section drawing, show that Robinson comes within, and therefore anticipates, the basic ratios of the patent in suit: overall height to width, walls of constant thickness, hollows larger than wall thickness, and half height to width.[7]

This argument appears to us an ingenious exercise in ex post facto extrapolation. Appellant bases measurements to the thousandths of an inch on a schematic, perspective drawing, without ratios or dimensions, to say that Robinson was concerned with the kind of weight distribution Latham and Brefka were confronting. One is tempted to say that a cross-section drawing of a double pipe fence or double-

[6] The trial court declared that "Spalding [has not] shown that [Robinson] developed into a viable tennis racket." Appellants attack this finding as wrong on the facts and the law. We do not attach much weight to Robinson's lack of immediate success. Even purely "paper" patents are relevant to questions of anticipation and obviousness. *Blohm & Voss AG* v. *Prudential-Grace Lines, Inc.*, 489 F.2d 231, 240 (4th Cir. 1973), *cert. denied*, 419 U.S. 840 (1974); *Siegel* v. *Watson*, 267 F.2d 621, 624 (D.C. Cir. 1958).

[7] Appellant also claims a sufficient separation of the hollows and a string-protecting groove to cover claims 2 and 4.

barrel shot gun would have made as good an example.[8] It may be that appellant, using such an approach, could have persuaded a judge to decree obviousness and that such a finding could have withstood appellate review. But, obviousness depending upon factual inquiries, *Graham* v. *John Deere Co.*, 383 U.S. 1, 17 (1966), appellant has a heavy burden in persuading us to reverse.

Robinson teaches the use of a three-piece assembly—two steel tubes and a fusing strip of probably lesser strength resulting in a seamed construction, with no directives as to the distribution of weight, the size, or proportions. To argue that Robinson, on this record, renders the patent in suit obvious as a matter of law is asking much. We would first have to assume that the object could be made by extruding aluminum. This we are willing to do. We then must assume, without evidence, that to one skilled in the art a single piece of extruded aluminum would appear superior and more practicable than a squashed and fused steel tube. We must then assume, again in the absence of evidence, that someone skilled in the art would have used the dimensions extrapolated by appellee from the schematic drawing and that this construction would have led him to the irregular external and internal shapes of the patent in issue. Appellant's witness testified only as to the rigidity and the addition to the width of the web imparted by the fusing strip. So little a part did Robinson play below that appellee's expert was not examined at all on the effect of this patent. He was

[8] Courts have been understandably loathe to rely on the elaborate scaling up of inexact drawings in prior patents. *Application of Wilson*, 312 F.2d 449 (C.C.P.A. 1963); *Application of Chitayat*, 408 F.2d 475 (C.C.P.A. 1969). These drawings are not always useless, however, even when the text of the patent is silent. If, without undue calculation or oversubtle inference, a drawing reveals that others have employed a principle that an applicant now seeks to patent, the applicant's efforts will face greater resistance; but even that resistance may be overcome. *Fowler* v. *Sponge Prods. Co.*, 246 F.2d 223, 226 (1st Cir. 1957).

shown a number of racket cross-sections, but at no time was he shown Robinson. And no one with qualifications in extruding was asked whether, in 1967, it would have been obvious, on seeing Robinson, to head toward Latham-Brefka. Finally, of course, the district court was entitled to take into consideration the secondary factor of the substantial success of the Smasher in entering the market, Spalding's sales of 200,000 aluminum rackets in 1968-1972, the prior unavailing efforts to devise a suitable metal racket, and the competitive emulation which fast followed.

We affirm the court's conclusion that Robinson did not render obvious the patent in suit. The Lacoste patent is no longer in the contest for paternity; we therefore turn to the Palmer patent.

The Palmer Patent

Appellant has admitted that Robinson "is a more effective reference against the patent in suit than either Palmer . . . or LaCoste [sic]." Palmer's patent, No. 3540728, calls for a cross-section in the shape of an ellipse, with either a notch roughly a fourth of the height in the right side or such notches on both sides, with a hole (of diameter roughly a fourth of the cross-section) at the top of the cross-section and a similar hole at the bottom. Appellant argues that it is a simple matter to lighten the construction by enlarging the holes. The district court held that the matter was not so simple.[9] While any enlargement of the hollows would reduce weight, the effect of the enlargements on the racket's strength is another matter. Appellant's

[9] Appellant has misspoken itself in claiming that the district court found the change to be "straightforward engineering not involving fundamental division of the original design." This reference was to what appellant did in converting appellee's two-hollow concept to a three-hollow one by hollowing out the center web. Appellant similarly appropriated to the argument for obviousness under Palmer testimony by appellee's expert addressed to the minimal change involved in converting appellant's two-hollow section into a three-hollow one.

illustrations of typical enlargements do not involve a symmetrical expansion of the hollows; they are irregular shapes, achieving the conformance to walls taught by the patent in suit.

We note also that Palmer taught several ways to lighten his frame, such as adding a groove and drilling horizontal holes, but he did not mention enlarging the existing holes. Appellee's expert testified that Palmer "does not go in [the] direction" of teaching enlargement of his round holes, but "digress[es] from a solution". This expert also testified that he did not find in Palmer the "basic design concept" in the patent in suit. What appellant's argument comes down to, save some hyperbole, is that as a matter of law we should conclude that a cookie with a hole in it not only makes obvious a doughnut but also a pretzel.

Appellant has a subsidiary argument, based on the district court's approach on another issue. As we discuss, *infra,* the court held that hollowing out the web of the patent in suit to form a tri-hollow frame was mere engineering. Appellant argues that if the same approach was brought to bear on Palmer, it would be deemed to anticipate, to be equivalent to, or to render obvious the patent in suit. That an operation proves simple in retrospect proves little, else surgeons would be paid only for their time in the operating room. Hollowing out a web described in a patent teaching weight distribution could be simply implementing the teaching. Widening a hole to make a countour conforming channel in a construct that embodied no teaching as to strength or conformity to walls could be sheer fortuity.

We agree with the Court's rejection of Palmer as a preclusive reference as did the Patent Office.

INFRINGEMENT

While the district court dealt with both bi-hollow and tri-hollow extrusions used by Spalding, the argument on appeal is addressed only to the tri-hollow racket frame made by Spalding. We reproduce it here.

The cross-section of this frame differs chiefly[10] from that of the patent in suit in that the portion separating the tubes is hollowed out, leaving struts connecting the two sides at top and bottom and the two sides linking top and bottom, instead of a solid portion penetrated only by a hole for a racket string.

Spalding, in its efforts to lighten and strengthen the cross-section, had first tried to narrow the center segment and found that inadequate space had been left for drilling the string hole. It then, sometime in 1969 hit upon the idea of hollowing out the segment. Long before this, in early 1968, Latham had made a sketch of a tri-hollow extrusion, crude but extraordinarily similar to Spalding's

[10] Spalding's tri-hollow also different in having larger dimensions than the patent in suit and in enlarging the tube hollows so that the walls followed the contours of the external sides, including those of the lips.

tri-hollow, and had discussed it with his patent attorney to insure that the patent would give as broad protection as possible.

The district court relied on testimony from both sides that the change from bi-hollow to tri-hollow was "straightforward engineering" and that the playability of the tri-hollow racket was indistinguishable from that of the bi-hollow. It held that the tri-hollow literally infringed the patent in suit, since, accepting the testimony of appellee's expert and construing the length of the horizontal struts as the width of the interconnecting web, the web had a material thickness more than twice the wall thickness of the tubes. It also held that even though there may not have been literal infringement, the hollowed center surrounded by struts and sides performed the same function as the interconnecting web described in the patent in suit, and, under the doctrine of equivalents, infringed.

Appellant's first argument is that under a plain reading of the claim ["an interconnecting web of material thickness that is more than twice the wall thickness of each tube"] each of the tri-hollow's two vertical walls is an interconnecting web, and that, even if they are added together and considered one web, their thickness is somewhat less than the thickness of the two struts (i.e., the tubes' abutting walls). Appellant adds that the two sides, or, in its view, webs are free to act independently and have less resistance to torsion. But appellee's expert defined the web as the sides plus the struts, the four attached segments acting together to prevent the structure from collapsing. We cannot say that this concept of "web" is not permitted by the claim language, particularly since, as we discuss *infra* in connection with the doctrine of equivalents, the inventors removed the adjective "solid" which they had earlier used in describing both "interconnecting web" and "material thickness". We therefore affirm the district court's conclu-

sion that the patent in suit reads directly on Spalding's tri-hollow cross-section.

Alternatively, we affirm the court's conclusion that the tri-hollow infringed the patent in suit under the doctrine of equivalents. This may be a closer question. The argument of appellant is a complex one. It has five steps. First, the inventors of the patent in suit, to distinguish their idea from the squashed tube effect of Lacoste, initially inserted the word "solid" to define both "interconnecting web" and "material thickness".[11] Second, the inventors later deleted "solid" in order, as their attorney wrote "to eliminate an immaterial limitation", since the web had a horizontal hole for a racket string. Third, "a limitation which is introduced into the claims in order to avoid the prior art will be strictly construed against the patentee . . . and . . . application of the doctrine of equivalents is superseded thereby." Fourth, since the attorney was talking only about horizontal or transverse drilled string holes, appellee is now estopped from claiming that "material thickness"—a change assertedly made to distinguish the non-attached tube sides of Lacoste's web—is anything other than solid mass, excepting only the transverse string hole. Appellant concludes "Thus, since the web limitation in the claim must be narrowly construed so as to avoid LaCoste [sic], so must it be narrowly construed when read on the accused structure."

We see two defects in this reasoning. The earlier amendment to insert "solid", was more than was necessary to distinguish Lacoste. The unifying of the structure was accomplished to the extent that the web attached to and is thicker than the two side walls. While a solid mass con-

[11] This may be so, but it seems clear to us that Lacoste's "web", consisting only of two tube sides pushed together, could not have a material thickness of more than the sum of its parts. The insertion of "solid", therefore, was not necessary to avoid Lacoste.

cededly achieves this effect to a maximum degree, solidity to the structure can be given by something less. With the dropping of "solid", Lacoste remains distinguished, it being clear that the web is an "interconnecting" one. Our second problem is that the particular patent history we discuss here is not the classic example of narrowly construing a limitation which has been added. Here a limitation, which the inventor's attorney described as an "immaterial" one, was dropped. Even if we assume that the inventors were thinking only of taking care of the transverse drilled hole and not of any additional longitudinal extruded hollow,[12] we have been cited to no authority compelling a narrow construction of a limitation which has been *removed* from a patent's claims. We therefore see no error in the district court's application of the doctrine of equivalents.

DAMAGES

The master in his report began by recognizing that many factors enter into a determination of what would constitute a reasonable royalty—conceded as the proper measure of damages.[13] He realized that giving each factor a numerical weight was not a realistic approach but noted that the patent was not exceedingly novel, that as merchandized by Spalding, the product was a luxury item, and that a license would be valuable to both parties. An important factor was the 1968 licensing agreement between the parties calling

[12] Appellee's expert testified that he construed the inventor's fear of someone getting around the patent by drilling holes to refer to longitudinal drilling. A lawyer witness for appellant testified at the hearing on damages, but not at the liability trial, that a longitudinal hole cannot be drilled in an extrusion. Perhaps more relevant to the intent or assumptions of the inventors is the evidence of Latham's sketch of a tri-hollow extrusion and his discussion with his patent attorney.

[13] For a list of fifteen factors that influence courts' decisions on a reasonable royalty, *see Georgia-Pacific Corp.* v. *United States Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D. N.Y. 1970), *modified*, 446 F.2d 295 (2d Cir. 1971), *cert. denied*, 404 U.S. 870 (1971).

for an 8.3 per cent royalty. This, of course, was prior to the issuance of a patent.

Plaintiff urged adoption of the same figure. A witness, an attorney experienced in drafting licensing agreements, gave his opinion that the 8.3 per cent figure was reasonable, the fact that the agreement would be non-exclusive being offset by the fact that the patent had issued. Defendant argued for a much lower figure. His arguments were considered seriatim. The master rejected the suggestion that Spalding entered the 1968 agreement in ignorance or error. He noted that during and after 1971 Spalding's profits on the Smasher rose consistently, with gross profits steadily exceeding 40 per cent. He acknowledged that a contemporary non-exclusive license would tend to lower the royalty rate but did not believe that confining the suppositious contemporary agreement to the domestic market would significantly affect a reasonable royalty rate, nor that such narrowing of the patent as took place would reduce the rate. He found no evidence that the presence in the 1968 agreement of a termination clause (which by hypothesis would not be a term of any contemporary agreement) had significantly raised the royalty rate. The master concluded that a reasonable royalty in a putative licensing agreement between the parties as of December 7, 1971, the date of issuance, would have been 5.5 per cent. The district court accepted the report and this figure.

On appeal, we face the expected barrage of criticism. We look only for error of considerable magnitude. Spalding's efforts to portray the value of the patent as of only a token amount seem to us attempted overkill. The master, while not attempting to assess the particular contribution of the patent compared to prior art, did recognize the limited novelty of the patent. Nevertheless, the Smasher and its successors did reasonably well despite the competition. Indeed a Spalding witness testified that the Smasher

had led its product lines in profit. Wilson, as late as 1973, was willing to enter a contract with Sullivan to create a new racket that might resemble Latham-Brefka. In any event, Spalding apparently continues to prefer products based on the patent in suit to available competitive models. Whether Spalding's belated calculations of net profit reflected proper management and cost allocation practices seems irrelevant; even if the net profit margin were very low, this is not dispositive of the determination of a reasonable royalty rate. Finally, the master is criticized for not giving specific attention in his report to license offers made by appellee to Spalding, to a development contract with Wilson, a competitor, and to an agreement between Wilson and Lacoste, all of these being in the neighborhood of 5 per cent. These, of course, are bases for legitimate argument, but the nature, terms, and timing of these other proposals and agreements are different enough from the supposed agreement which the master had in mind that we find them less than compelling criticism of the rate chosen by the master and endorsed by the court.

In sum we are unable to say that the court erred in accepting the master's recommendation that, in 1971, after the issuance of a patent, a reasonable rate of 5.5 per cent, substantially less than the pre-patent 1968 rate, is reasonable. It seems to us that the balance between advantages and disadvantages has not been unfairly struck.

The master also recommended that damages be doubled, i.e., that the royalty rate be 11 per cent of the wholesale price of each unit sold and not returned from December 7, 1971 through 1975. On sales of $5,346,621, this amounted to $592,528, exclusive of interest. The court accepted the recommendation. What impressed the master was appellant's awareness that a patent had been applied for and granted, its knowledge gained from experience under the 1968 licensing agreement, and its failure to obtain an

opinion from a source expert in the design and manufacture of tennis rackets. The master referred to the opinion of appellant's patent counsel, Bahr, as "hardly . . . unbiased" since in 1970, before the patent had issued, he had recommended that appellant take its chances.

Our review is addressed to the question: did the master and the court abuse their discretion in concluding that appellant acted unreasonably? *Russell Box Co.* v. *Grant Paper Box Co.*, 203 F.2d 177 (1st Cir. 1953). Appellant's action in terminating the license agreement was stimulated by attorney Bahr. Bahr's memorandum, in March of 1970, was written when Sullivan's patent application had been rejected by the Patent Office. Bahr thought the chances of Sullivan getting significant patent protection on appeal were minimal, "particularly in view of the fact that on appeal the Patent Examiner's position is usually affirmed 75% of the time." Bahr also thought that the Spalding Smasher was not infringing, noting that it was not using a weighted strip on the periphery of the head. As for the basic extrusion cross-section described in the patent application, Bahr noted that "plans are afoot at Spalding at the present time to design around this extrusion cross section." New dies had been ordered, rackets would be built, and tests run. Bahr's assessment was: "The risk [of being found to infringe] is not significant as the royalties which would be owing during the period when Sullivan would be attempting to perfect his patent position would more than provide ample capital to either re-design around the patent, or to file an action for declaratory judgment for purposes of contesting its validity."

As of this point the district court could justifiably have felt that reasonableness had not been demonstrated. Appellant could not know the content of the patent in suit, since it did not in fact issue until 21 months later. There was no detailed assessment of then existing claims. Bahr was

in part gambling on the small percentage of successful appeals from the examiner. The "design around" effort had not been reduced to fabrication and tests. So far as Bahr's recommendation is concerned, it could be viewed by the district court not so much as an opinion on the merits of the patent in suit as a business judgment based on a shrewd calculation of risks. Bahr also appeared to be running for luck when he informed Spalding production people in May of 1970 that there was no longer a patent pending on the Smasher. In September, 1970, Bahr was urging that production on the tri-hollow be expedited to "completely eliminate our worries about Mr. Sullivan's possible patent position." While Bahr served on the patent committee with Spalding's technical expert, Maxwell, the latter had never read nor discussed the patent in suit until he was deposed for this litigation.

Nor, so far as we know, did appellant seek outside counsel until the patent in suit had issued. In January, 1972, it sought an opinion from a patent attorney, Ernsberger, who, while "outside", had done work for Spalding's parent since the 'twenties. He made a purely legal analysis of the patent and concluded that the tri-hollow would not infringe the patent in suit.

Shortly after his opinion was received, in mid February, Bahr met with Paul Sullivan, Latham, Spalding personnel, and their lawyers concerning new negotiations relating to the Smasher racket. Bahr's inter-office memo of February 23, 1972 noted his opinion that the new throat piece on the Smasher did not infringe Sullivan's design patent and that he would be obtaining "a confirming opinion on this point in the near future." He also referred to having two confirming opinions on the tri-hollow.[14] He concluded, "Accordingly, it is my strategy to stall for as much time as

[14] We are aware only of Ernsberger's.

possible in order to allow us to use our existing supply of Smasher rackets which incorporate the old throat piece design."

Finally, appellant called as a witness an experienced patent attorney, Chittick. While Chittick concurred in the view that Spalding's tri-hollow did not infringe the patent in suit, he conceded that as a non-tennis player he could not determine whether a supposed equivalent would function in the same way to produce the same result. He also said that if a client of his was under a license agreement and was trying to design around the patent under license, he would be extremely cautious.

While double damages may be thought to be rough usage of parties to patent disputes who necessarily must take risks, we do not see how, on this record, we can do other than affirm the district court.

Affirmed.

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

Civil Action No. 72-3344-T

PAUL SULLIVAN SPORTS, INC.,
PLAINTIFF,
v.
A. G. SPALDING & BROS., INC.,
and
QUESTOR CORPORATION,
DEFENDANTS.

OPINION
October 20, 1975

TAURO, D.J.

This is an action by Paul Sullivan Sports, Inc. [Sullivan] against A. G. Spalding & Bros. [Spalding], a division of Questor Corporation. Sullivan has claimed infringement by Spalding of various claims of U.S. Patent 3,625,512 owned by Sullivan as assignee of the inventors, Peter A. Latham and Paul E. Brefka. Spalding has denied infringement and has asserted the invalidity of the patent.

The patent in suit covers the internal design of an aluminum tennis racket frame.

The frame is formed from a single extruded piece of aluminum which is bent to form the handle, throat and head of the racket. The extrusion is characterized by a transverse cross-section which contains hollow tubes joined together by an interconnecting web. Appendix A.

I.

BACKGROUND

The development of a high quality tennis racket is not a simple or obvious task, involving as it does the blending of sophisticated engineering concepts with highly subjective playability factors. Engineering considerations include:

bending about both longitudinal and transverse axes taken through the cross-section of the frame; the frame's torsional characteristics, weight, balance, strength, and tension resistance as well as its overall durability. Trial Transcript [hereinafter TR.] 1-31-45; 3-32; 33; 5-123, 124.

Playability factors include the racket's feel, softness, springiness, vibration, power, balance, ease of control, its response to on-center and off-center hits and its aesthetic appearance.

Metal tennis rackets first appeared on the market during the 1920s when Spalding Brothers, and others,[1] manufactured and sold aluminum rackets. The quality of these rackets, however, was somewhat below expectation and sales were discontinued in the early 1930s. TR. 2-141; 6-117, 118, 119.

From 1933 until 1969 Spalding continued unsuccessfully, its efforts to market a satisfactory metal racket, including some designed by outsiders. PX 107-7-13. One outside design Spalding rejected was submitted by a French engineer, Rene LaCoste. LaCoste proposed a racket which could be made from steel, had a generally squashed tube configuration and used strings which were suspended from a spiral wire wrapped around the frame, rather than being sent through holes drilled through the head. LaCoste's design attracted the attention of Spalding's competition, the Wilson Sporting Good's Company. Wilson acquired the rights to the LaCoste patent, and by the late 1960s, was producing a racket based upon it, the T-2000, which proved to be a highly popular piece of tennis equipment. TR. 2-107; PX 12, 107-17, 18.

II.

DEVELOPMENT OF THE SMASHER

In August 1967, Paul Sullivan, a nationally ranked tennis player, and Peter Latham, a tennis enthusiast and engi-

[1] The Dayton Tennis Racket Company also manufactured metal tennis rackets in the 1920s and 1930s. TR. 5-12, 13, 14.

neer, found themselves seated together at a national doubles tournament at the Longwood Cricket Club. They began talking about the Wilson T-2000, particularly its vibration or "trampoline effect" when the racket hit the ball. Both felt that a metal racket with better playing characteristics than the T-2000 could be developed. Accordingly, they decided to enter into such a project, TR. 2-100, 101; 3-29-33, with Paul Sullivan providing the player's expertise and Peter Latham's firm, LBA,[2] which included his partner Paula Brefka, providing the mechanical engineering. After some consideration of possible materials and some preliminary engineering calculations, LBA decided that project was feasible and Paul Sullivan approached Spalding, with whom he had some prior business contacts, in an attempt to interest it in underwriting such a project. Spalding's management was not interested. TR. 2-100-104, 3-5-6, 29-43.

Paul Sullivan and LBA then understook the task on their own. Initially LBA designed and tested I beams and solid cross sections. The I beam and solid models, however, performed poorly and they were eventually abandoned in favor of double hollow configurations. TR. 2-101-104, 3-5-6, 24-43. By December, 1967, a prototype double hollow racket was produced by LBA which Paul Sullivan felt exhibited excellent playing characteristics. It had negligible vibration and played extremely well, allowing him to get into position faster, hit harder and control the ball better than the Wilson T-2000. PX 2-29. This prototype racket was substantially the design embodied in the patent in suit. TR. 2-105, 107, 141.

Having achieved a successful racket, Sullivan then formed his own company, Paul Sullivan Sports, Inc., to engineer, manufacture and distribute it. He took prototype rackets

[2] LBA was once known as LDA. The company will be referred to as LBA throughout this opinion, although the parties have used the two designations interchangeably in memoranda and at trial.

to a New York sports show in early January 1968 to confer with people who had expressed an interest in selling them. At this show a Spalding official saw the prototype rackets and expressed enthusiasm. He urged Paul Sullivan to consider letting Spalding handle the racket's production and marketing. TR. 2-105, 106, 3-7.

Within a few days, Paul Sullivan and Peter Latham met with the top management of Spalding. At about the same time LBA filed the patent application, which in December 1971 issued as the patent in suit.

In January 1968 two meetings took place at Spalding's headquarters in Chicopee, Massachusetts. At the initial meeting Paul Sullivan showed the racket to Spalding representatives, including James Norris, Spalding's Vice President of Marketing. A second more extensive meeting took place shortly thereafter and included Sullivan, Latham, Brefka, Kerry Lyne, (a lawyer for Paul Sullivan Sports, Inc.) and President Parker of Spalding. During that meeting Paul Brefka and Spalding engineers went to the engineering department where a prototype aluminum racket brought by LBA was "whack"[3] tested. The results of this whack test were reported during this meeting to Parker. The report was to the effect that the racket took a set, it bent and held the bend to some degree permanently. TR. 2-108-110.

Mindful of the results of its whack test,[4] Spalding none-

[3] The whack test is carried out on a machine which causes a tennis racket to strike a tennis ball repeatedly to determine whether deflection of the racket occurs. It was designed originally for testing wooden rackets and places greater stress upon the racket than would be expected in normal use. In the Spalding whack test the racket is not reversed in place so that all of the hits strike one face of the racket. Because the machine had not been specifically set up for the Sullivan prototype this first whack test was carried out under somewhat improvised conditions. TR. 2-105-109; 3-7.

[4] Spalding arranged for the prototype racket to be tested by a number of professionals, although the results of these tests are not made clear in the record.

theless, pursued serious negotiations with Sullivan, stressing the potential profitability of a long term arrangement. Thereafter, on February 13, 1968, Spalding entered into a license arrangement with Sullivan, TR 2-110; 6-100, PX 65, providing for its exclusive right to manufacture the subject invention with a royalty to Sullivan for every racket sold thereunder. The license provided for termination under certain conditions and provided that upon such termination Spalding would not infringe on any valid patent claim that Paul Sullivan Sports, Inc. might have. PX 65.

During the period from 1968 through 1971 Spalding modified the prototype racket by moving material from the portion of the extrusion cross-section closest to the neutral axes out to peripheral areas. These modified cross-sections (Nos. 3, 5A and 6A) embody the same basic structure as the subject prototype. TR. 1-72, 77, 83, 86; PX 36; 38; 58; 59; 99-19. The Spalding racket cross-section designated 6A is typical of the bi-hollow cross-sections manufactured by Spalding. PX 87-11.

In May 1968 Spalding first sold aluminum tennis rackets based upon the No. 3 cross-section or the No. 5A cross-section, under the trademark "Smasher". In the balance of that year, Spalding sold approximately 8,500 rackets. In 1969 it sold more than 50,000. The volume of Smasher sales continued at a high rate up to the date of suit (November 1972). DX-P.

From the introduction of the commercial racket by Spalding in May 1968 through March, 1970, all aluminum rackets manufactured by Spalding bore the designation "patent pending", referring to the application which has matured into the patent in suit. All of the rackets had affixed to them a label which read "Paul Sullivan AR-1 designed by LBA". TR. 2-131; PX 89.

When Spalding publicly announced the Smasher racket on May 15, 1968, it praised it as one of the most significant

technological advances in the history of the sport and made other highly laudatory comments about its playing characteristics. These statement were later affirmed by Mr. James Long, an officer and designated witness of the defendant, in a series of press releases, PX 80; 81; 82.

Many nationally ranked tennis players including Gardner Malloy, Cliff Drysdale and Bobby Lutz played with and praised the Smasher. Pancho Gonzales played with the Smasher and, although he made minor modifications, he continued to play with the racket over a long period, liked the racket, won major tournaments with it, and stated that it improved his game 25%. TR. 3-12, 20, 21; PX 60; 62; 63; 80; 82; 107-126; 127.

After Spalding introduced the Smasher, a number of copies were marketed by companies such as Chemold. TR. 1-134; 3-14; PX 65; 66; 127-121.

In early 1970, Spalding's patent attorney, Mr. Bahr, reviewed Spalding's license with Sullivan. He knew a patent had not yet issued and believed that the only patent claims that would be allowed would be directed to a flexible strip feature for protecting the strings. He, therefore, advised Spalding to terminate the license under a provision in the agreement which required Sullivan to prevent unlicensed competition. Sullivan, of course, not yet having his patent issued, could not then stop competitor copying. Mr. Bahr pointed out that even if a patent should issue covering the Smasher, the money saved on royalties could be utilized to finance a lawsuit aimed at invalidating the patent.

> The risk is not significant as the royalties which would be owed during the period when Sullivan would be attempting to perfect his patent position would more than provide ample capital to either re-design around the patent, or to file an action for declaratory judgment for purposes of contesting its validity. PX 78.

Additionally, he noted that plans were afoot to "design around" the Sullivan racket. The extrusion resulting from this "design around" program was the so-called 9A "triple hollow" extrusion. This cross section was created by removing material from the center of the web to hollow it out and then adding material to the outer portions. TR. 1-119, 132-36; 2-117-23; PX 55; 57.

Spalding adopted the opinion of counsel and in March 1970, terminated its license with Sullivan. Since that date it has manufactured and sold the Smasher, based on its modifications of the LBA design, without paying royalties. When the patent in suit issued in December 1971, Sullivan offered to reinstate the license agreement, but was rebuffed. In November 1972, Sullivan instituted this lawsuit against Spalding.

Sullivan alleges that Spalding has infringed the claims of the patent in suit under 35 U.S.C. § 271 by the manufacture and sale of the Smasher. It now seeks an injunction under 35 U.S.C. § 283, an accounting for past infringement and reasonable royalties under 35 U.S.C. § 284, attorney's fees under 35 U.S.C. § 285 and its costs. Spalding responds that the patent in suit is invalid because it has been anticipated by prior patents in the field, 35 U.S.C. § 102(d), that Latham and Brefka are not its original inventors, 35 U.S.C. § 102(e), that its teachings were obvious to anyone skilled in the field in 1967, 35 U.S.C. § 103, and that it is unenforceable by virtue of fraud on the Patent Office. Spalding also argues that Sullivan's claims have not been infringed, 35 U.S.C. § 282, and seeks an award of costs, attorney's fees and exemplary damages for Sullivan's allegedly knowing submission of false evidence to and withholding of pertinent evidence from the Patent Office.

III.

Validity

The initial question in this lawsuit is the validity of the claims of the patent in suit. In dealing with this issue, a court must begin with the presumption that the patent is valid, *Shanklin Corp.* v. *Springfield Photo Mount,* F.2d (1st Cir. 1975); *Eversharp Inc.* v. *Fisher Pen Co.,* 204 F. Supp. 649, 671 (N.D. Ill. 1961), and that the Patent Office's decision cannot be overturned without strong and convincing evidence supporting the position of the party alleging invalidity. 35 U.S.C. § 282; *Mumm* v. *Jacob E. Decker & Sons,* 301 U.S. 168 (1937). Moreover, the presumption is enhanced where, as here, the principal prior art relied upon by the defendant has already been considered by the Patent Office in approving the patent, or consists mostly of "paper" patents, without a showing of their practical success.

In its attempt to rebut this presumption, Spalding raises a series of arguments which will be considered seriatim.

A.

Anticipation under 35 U.S.C. § 102(a).

Spalding has argued that one previous patent, the so-called Palmer Reference, PX 7, provides a complete anticipation under 35 U.S.C. 102(a) because the structure which it discloses, contains all of the elements of the claimed invention. *Shanklin Corp.* v. *Springfield Photo Mount,* F.2d (1st Cir. 1975); see 1 Walker on Patents § 57 (Deller ed. 1964). Put another way, if the patent in suit came before Palmer, Palmer would infringe. *Congoleum Industries Inc.* v. *Armstrong Cork Co.,* 339 F. Supp. 1036 (E.D. Pa. 1973), *aff'd,* 510 F.2d 334 (3rd Cir.), *cert. denied,* 95 S. Ct. 1991 (1975).

The doctrine of anticipation is a technical defense, one which is normally strictly construed. And, as Learned Hand noted in *Dewey & Almy Chemical Co.* v. *Mimex Co., Inc.,* 124 F.2d 986, 989 (2d Cir. 1942):

> No doctrine of the patent law is better established than that a prior patent or other publication to be an anticipation must bear within its four corners adequate directions for the practice of the patent invalidated. If the earlier disclosure offers no more than a starting point for further experiments, if its teaching will sometimes succeed and sometimes fail, if it does not inform the art without more how to practice the new invention, it has not correspondingly enriched the store of common knowledge, and it is not an anticipation. (Footnote omitted)

Viewed against this well-developed, and exacting standard, Spalding's claim that Palmer anticipated the patent in suit must be rejected. Appendix B.

Claims one through five of the patent in suit teach a tennis racket frame characterized by a cross-section containing two seamless hollow tubes, each hollow with a shape substantially corresponding to the exterior of the tube. The wall thickness formed between the two hollow tubes is substantially constant. The patent also discloses the cross-section configuration and dimensions from which the wall thickness, web thickness and open sizes may be determined.

The design disclosed by Palmer, however, is fundamentally different. This patent does not show or describe a *tubular* structure or suggest a light weight *tubular* frame with a supporting center web. Nor is there any evidence that Palmer was ever fabricated, used by a tennis player or that it achieved commercial or professional acceptance. Figure 7 of the Palmer patent, on which the Spalding places primary reliance, reveals a form with holes, but provides no dimensions, ratio or other specifications. Indeed, faced with the problem of producing a light-weight racket, Palmer teaches five techniques for lightening the frame, including placing a groove on the outside of the cross-section, placing a groove on the inside of the cross-section, and using a

lightweight tubular sheath. If anything, the Palmer teachings would lead one skilled in the art, away from, rather than toward, the solution disclosed by Latham and Brefka. TR. 1-48, 2-57, 70, 5-118-120, 135-36; PX 7, 103. The testimony of Dr. Stephen Loutrel, highlighted the differences between Palmer and the patent in suit.

> The Court: What do you see as a fundamental difference, if I may ask, between the Palmer and the Latham?
>
> The Witness: Well, the Palmer cross section—if you read the Palmer patent—started out as a solid cross section without those two holes in the end of it. As a thought, he mentions that if that is too heavy, you could go and drill holes in it, as he shows there, to lighten it up. He says then that if it is still too heavy, you could cut a groove, such as 4[1] on the right side on back side. You could have two grooves, which has now led us to a figure 8 shape or more of a figure 8 shape.
>
> He still, in my opinion, is not talking about a tubular structure where you're trying to work with as thin a tube wall as possible as far removed from the neutral axis as possible, and I don't feel that he really teaches the cross section on the right. I would agree that I think that is the closest.

TR. 1-48. Subsequently on cross-examination Dr. Loutrel explained further:

> . . . What I mean to say is that the Palmer patent in its teaching starts out with a solid cross section, a solid extrusion. From there it simply mentions that you can, if it is too heavy, lighten it some by putting holes in the cross section. It then says if that's still too heavy, you go on and cut a groove in the back side.
>
> Now nowhere in the Palmer patent do I read any teaching to the extent of a lightweight tubular frame

with a supporting web in the center, and to me that's a fundamental difference.

TR. 2-57. And later on, Dr. Loutrel stated:

> Well, there are a bunch of things in what you have just said that I hate to just let pass by. For instance, one thing you said was that Palmer teaches a method for making the tubes as light as you wish, and I don't feel that he does. I feel that he says he does, but if you were to take just what he has there and try to make it lighter by drilling holes and cutting that web in the back side and all, you would probably, or very possibly, digress from a solution which would be a satisfactory high-quality tennis racket.

TR. 2-70.

At the trial, Spalding's expert, Dr. Kern, in an attempt to explain his statement that Palmer did include all of the elements of the claims, used a partially transparent overlay on a chart which included an enlarged cross-section of Figs. 7 and 8 of Palmer. DX RR. The transparency included a green circular ring of constant wall thickness. His testimony concerning this exhibit, however, actually underscored the fact that the extrusion of Palmer could not be construed as a tube and that the internal hollow failed entirely to conform to the shape of the exterior.[5]

Since the teaching of Palmer involved relatively compli-

[5] In fact, on cross examination, Dr. Kern conceded that the opening in Palmer was round, that a tube having the same exterior shape would also have to be round, and that the exterior shape of Palmer was not round. TR. 6-18, 19.

Moreover, Dr. Kern was unaware that the cross-section of Palmer Fig. 7, was intended for a light or lady's racket and that, accordingly, the cross-sectional area (not shown or disclosed in the Palmer reference) which he arbitrarily assigned to the Palmer racket was an entirely inappropriate value. TR. 5-110. He believed that there were only two teachings in Palmer for making the racket frame lighter rather than the five which actually appear. TR. 5-11, 118. None of these five teachings included shaping openings to conform to the exterior extrusion shape.

cated solutions of the problem of weight reduction, such as placing grooves around the exterior or interior of the extrusion, tapering the handles to reduce weight, and utilizing a "torque box" handle construction, it would appear that the solution of the patent in suit did not occur to Palmer when he filed his application in 1967.

Spalding argues that Palmer meets the claim of the patent in suit by citing Dr. Kern's testimony that the wall of the tube in the patent in suit is of substantially constant thickness only for 55% of its circumference, whereas Palmer's is substantially constant for 45% of its circumference. Yet, this representation is predicated on the false assumption that, absent precise specifications, a patent drawing may be enlarged and measured to produce accurate dimensions, an assumption directly contrary to the rule as set forth by the Court of Customs and Patent Appeals in *Application of Citayat*, 408 F.2d 475 (1969):

> In view of the absence in Frank's specification of any written description of the quantitative value of the image displacement relative to fiber diameter, the *arguments based on mere measurement of the drawings appear to us of little value.* As we said when faced with an analogous situation in *In re Wilson et al.*, 50 CCPA 827, 312 F.2d 449, 136 USPQ 188, 192:
>
> > Both the Patent Office and appellants have engaged in what appears to us to be a somewhat futile attempt to measure the thickness of the Weisse coil strip and the Weisse lap spacing in their respective attempts to show whether the particular lap spacing recitations included in the claims now before us are or are not distinguishable from those disclosed by Weisse. Appellants, for example, conclude, in typically precise fashion, that the Weisse lap spacing is "about 30% to 60% greater than applicants' top spacing." *Patent*

> *drawings are not working drawings and this argument is predicated, moreover, on a greatly enlarged section of a small drawing obviously never intended to show the dimensions of anything.* We do not find it persuasive. (Emphasis added).

408 F.2d at 478.

Accordingly, the court holds that the patent in suit was not anticipated by the Palmer reference under 35 U.S.C. § 102(a).

B.

ANTICIPATION UNDER 35 U.S.C. § 102(e).

Spalding next argues that the patent in suit was anticipated under 35 U.S.C. § 102(e) because Latham and Brefka were allegedly not its original inventors. Specifically, Spalding claims that the design concept originated with Dr. Kurt Glaser of Reynolds Aluminum who first suggested a bi-hollow tubular structure to Latham at a meeting in November 1967.

The only evidence in support of this theory was a deposition of Dr. Glaser introduced by Spalding on the last day of trial. Although not particularly clear on the times and places of various and events the meaning of a number of Reynolds documents, Glaser did testify that a meeting at Reynolds offices took place in the fall of 1967 and that he, Latham and Dr. Gilbert Shockley of Reynolds attended. According to Glaser's version, Latham at that time was still considering solid or I beam cross-sections and that after listening to Latham's presentation, he, Glaser, suggested use of a bi-hollow. Moreover, Glaser, indicated that he was able to come up with an acceptable design at that very meeting and provide data to a Reynolds technician who prepared a drawing of the proposal.[6] DX FFF-13-17, 20, 105-08.

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[6] Spalding argues that Latham hid his connection with the Glaser until the eve of trial. The Glaser deposition, however, indicates that he had a series of meetings with Latham in late 1967 and early 1968 and that one of those meetings included Brefka and two representatives from Spalding. DX FFF-77.

Closer examination of the testimony, however, casts significant doubt about this version. On cross-examination Glaser conceded that in 1967 he had no previous experience in designing or extruding tennis rackets, DX FFF-71, 102, and that he really could not recollect who first suggested the bi-hollow design. DX FFF-101. Moreover, Dr. Loutrel, plaintiff's engineering expert, testified that the drawing which Glaser claims originated with Reynolds personnel, PX 105 [sometimes referred to as DX HH], was actually a tracing of an earlier drawing, PX 35, done by LBA. TR. 6-132-38. Indeed, in spite of two volumes of documents, introduced by the defendant, DX A, and the apparent availability of Dr. Schockley as a defense witness, no corroboration of Dr. Glaser's initial testimony was offered.

In dealing with claims of prior inventorship, courts have imposed an extremely heavy burden on the party seeking to challenge the patentee's claim. This is especially true when the evidence in support of the defendant's position is uncorroborated and undocumented. As the Court stated in *Washburn & Moen Manufacturing Co.* v. *Beat 'Em All Barbed Wire Co.*, 143 U.S. 275, 284 (1892):

> In view of the unsatisfactory character of such testimony, arising from the forgetfulness of witnesses, their liability to mistakes, their proneness to recollect things as the party calling them would have them recollect them, aside from the temptation to actual perjury, courts have not only imposed upon defendants the burden of proving such devices, but have required that the proof shall be clear, satisfactory, and beyond a reasonable doubt. Witnesses whose memories are prodded by the eagerness of interested parties to elicit testimony favorable to themselves are not usually to be depended upon for accurate information.

Accord, Hap Corporation v. *Heyman Manufacturing Co.*, 311 F.2d 839 (1st Cir. 1962).

There being a lack of credible evidence as to prior inventorship in this case, the court cannot sustain Spalding's challenge of Latham and Brefka as the inventors of the patent in suit.

C.

OBVIOUSNESS

Spalding next argues that the patent in suit is invalid because a person skilled in the art in 1967 would have been able to design the cross section embodied in the patent in suit as an exercise of ordinary skill.

The determination of obviousness, of course, is a question of fact, requiring inquiry into a wide range of issues, including "the scope and content of the prior art, the differences between the prior art and the claims in issue, and the level of ordinary skill in the particular art—as well as possible consideration of such secondary factors as commercial success, long felt but unresolved needs, and failure of others." *Shanklin Corp.* v. *Springfield Photo Mount,* F.2d (1st Cir. 1975). *See Graham* v. *John Deere Co.,* 383 U.S. 1, 17-18 (1966); *Koppers Co.* v. *Foster Grant Co.,* 396 F.2d 370 (1st Cir. 1968).

Although defendant cites seventeen American and foreign patents as prior art examples it relies principally on three, the Palmer, LaCoste and Robinson. Yet, of these three patents, two, Palmer and LaCoste, were already considered by the patent office in approving the patent in suit while only one, LaCoste, has produced a commercially viable racket. Moreover, a review of the key features of the patents relied upon by the defendant, makes it clear their teachings would not make the development of the patent in suit an obvious one.

1. *The Palmer Reference*

Spalding argues that an engineer starting with the Palmer patent need only perform the routine function of removing material from the cross-section in order to come

up with the patent in suit. *See* Part III, 3 *infra.* In that way, the cross section would be lightened, without appreciably affecting its strength. The fallacy of this argument, however, is that a change from Palmer to the patent in suit involves more than merely placing a hole, or increasing the size of a hole, through the length of the Palmer design. Rather, it involves changing a racket of unknown dimension or potential, formed by an eliptical bar with holes, into a sophisticated bi-hollow structure with its conforming walls having demonstrated capability.[7]

The defendant's reliance upon the testimony of his experts Mr. Lewis Warner and Dr. Kern on this point is also misplaced. Although Warner indicated that a man skilled in the art in 1967 would have found it obvious to remove material from the interior of the extrusion to lighten it, he did not indicate what, if any, effect such a procedure would have on the strength of a frame based on the Palmer design. And, Dr. Kern, while also conceding that removal of interior matter would lighten the frame, carefully noted that changes in design modifications alone do not necessarily produce a playable tennis racket. TR. 5-103. In short, the Palmer reference provides too limited a disclosure to make obvious the ideas embodied in the patent in suit.[8]

2. *The LaCoste Reference*

The LaCoste patent describes a squashed tube racket with playing characteristics markedly different from those of the patent in suit. It is not a structure with seam-

[7] Dr. Loutrel characterized the differences between the two structures as fundamental. TR. 1-57. *See* Part III, A. *supra.* The court agrees with that conclusion.

[8] The Palmer reference was the chief reference relied upon by the Patent Examiner in reopening the patent examination on appeal, PX 2-107, and served as the impetus for amendments to the claims insisted upon by the examiner before acceptance of the patent in suit. PX 2-106, 109.

less hollow tubes, characterized by a material thickness twice the wall thickness of the tubes themselves. Nor does its commercial embodiment, the T-2000, a stringing system requiring holes to be drilled in the frame. In fact, the LaCoste patent does not have any materials connecting its internal walls, but rather allows the walls to act independently of each other. TR. 1-29, 2-107, 4-93, 5-37, 38; PX 2-76, 52-54, 64-67; 12.

Assuming arguendo, that there are some similarities between LaCoste and LBA the differences between the two designs remain significant. From an engineering viewpoint, the testimony of Dr. Kern indicates that the torsional characteristics of the LaCoste configurations would be weaker than those of the patent in suit. TR. 5-128. And, from a playability standpoint, the patent in suit was successful in alleviating a serious problem, the "trampoline effect," which had characterized the Wilson T-2000.[9] LaCoste's invention, therefore, hardly made obvious the claim of the patent in suit.

3. *The Robinson Reference*

The Robinson patent relied upon by the defendant, No. 1,930,285, was issued in 1933 and was directed toward a large number of tubular structures and fabrication techniques. These included ski poles, screen door panels, and camera tripods. None of these patents teach a seamless hollow tube joined by an interconnecting web of more than twice the wall thickness, nor has Spalding shown that any of these structures have been developed into a viable tennis racket. Accordingly, a claim of obviousness based on Robinson must also be rejected. TR. 1-29; 2-26; PX 6, 9.

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[9] A second embodiment of the LaCoste design, the Revere racket, also exhibited playing characteristics different from those in the patent in suit. PX 2-64-67.

4. *Secondary Factors*

A number of other factors buttress a finding of non-obviousness. Prior to the introduction of the Smasher, there had been a long-felt need for a racket of this type; and others having attempted to develop one for about thirty years. When Spalding finally obtained rights to the patent in suit, it hit upon an immediate success, selling 200,000 aluminum rackets between May 1968 and November 1972. TR. 3-12, 20, 21, PX 60-63, 82, 109-26. Indeed, in introducing the Smasher, Spalding praised it lavishly, citing it as one of the most significant technological achievements in the history of the sport. The racket was also subject to widespread copying by competitors. TR. 1-134; 3-14; PX 55, 66, 107-121, 122. While these considerations, standing alone, might not support a finding of patentability, they do add significant support to a conclusion that the patent in suit was not achieved merely by application of ordinary skills known to those in the art in 1967. *See Graham* v. *John Deere Co.*, 383 U.S. 1 (1966); *Rich Products Corporation* v. *Mitchell Foods, Inc.*, 357 F.2d 176 (2d Cir. 1966); *A. M. P. Inc.* v. *Molex Products Co.*, 329 F. Supp. 1364 (N.D. Ill. 1971); *Columbia Broadcasting System* v. *Sylvania Electric Products, Inc.*, 294 F. Supp. 468 (D. Mass. 1968).[10]

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[10] Spalding's argument that the patent in suit is invalid under 35 U.S.C. § 112 because it failed to specify the aluminum alloy from which the racket frame of the preferred embodiment should be fabricated is without merit. The aluminum alloy used was 6061-T6 which, as Dr. Loutrel testified, certainly would have been the first choice of anyone skilled in the art. TR. 1-63, PX 30.

Spalding also argues that certain amendments to the specifications should not have been allowed under 35 U.S.C. § 132 because they allegedly included "new matter." The Patent Office has already rejected this argument when it allowed the amendments, and there is nothing in the record which would allow this court to avoid giving that decision the "special weight" to which it is normally entitled. *Dart Industries Inc.* v. *E. I. duPont de Nemours*, 348 F. Supp. 1338, 1357 (N.D. Ill. 1972), *rev'd on other grounds*, 489 F.2d 1359 (7th Cir. 1973), *cert. denied*, 417 U.S. 933 (1974).

III.

Infringement

The next issues center upon Sullivan's contention that Spalding has infringed the claims of the LBA patent by its manufacture and production of Smasher rackets based upon the 5A, 6A and 9A extrusions.

The basic test of infringement is whether or not the accused matter falls clearly within the claim of the patent. *Graver Manufacturing Co.* v. *Linde Co.*, 339 U.S. 605 (1950). Alternatively, if the challenged device does not meet this literal standard, infringement may still be made out under the "doctrine of equivalents" if the patented and challenged device "do the same work in substantially the same way, and accomplish substantially the same result." *Sanitary Refrigerator Co.* v. *Winters*, 280 U.S. 30, 42 (1929).

A. *The bi-hollow rackets*

Dr. Loutrel testified that claims 1 through 5 of the patent in suit read directly onto both the 5A and 6A bi-hollow extrusions. Appendix C , PX 43, 55, 45, 46; TR. 1-91, 96, 98, 100. Indeed, the only real controversy regarding infringement of these claims by the 5A and 6A is the assertion by Spalding that one common element of each of those claims is not met by the Spalding modifications. Specifically, with regard to those extrusions, Spalding argues that it cannot be said that

> . . . the exterior cross-sectional dimension of each of said tubes be significantly greater in the direction perpendicular to the stringing plane measured from the center of said extrusion to each end than in the direction parallel to the stringing plane measured across said interconnecting web from one side of the extrusion to the other.

Or, more simply, the defendant contends that in the 5A and 6A extrusions, the distance from the center of the stringing plane to the top of the cross-section is *not* substantially greater than the dimension across the tube measured at the web. This theory is without merit.

The premise of the defendant's contention is that the term "dimension parallel to the stringing plane" should be read to mean "*maximum* dimension parallel to the stringing plane," and that the width of the tube should be measured at the "lips" of the extrusion. TR. 6-20. The claim itself, however, explicitly teaches that the dimension parallel to the stringing plane is to be measured "across the web," or, as Dr. Loutrel noted, where the tube and the web intersect. TR. 2-31. Viewed in this way, the parallel dimension in the 5A extrusion is .283 inches while the perpendicular measurement is .375 inches, PX 41, which, as defendant's expert conceded, represents a substantial difference between the two. TR. 6-22. An examination of the measurements on the 6A exclusion, PX 38, yields a similar result. TR. 1-85-86.

The defendant responds by arguing that the limitations appearing in claims 1 through 5 are not "meaningful" for they do not describe any critical characteristic of the extrusion. Yet, as Dr. Maxwell, in his deposition as Spalding's engineering supervisor noted, the dimension across the web of the 6A cross-section "describes the strength characteristic in that direction . . ." PX 99-70. And, as Spalding is undoubtedly aware, all of the aluminum tennis rackets manufactured and sold by it are characterized by cross-sections which do meet all of the claim limitations, and that these are the only metal extrusions which have succeeded for Spalding despite thirty years of effort in the field.[11]

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[11] The defendant argues that the 5A cross-section avoids infringement because its hollows are not "generally rectangular." In view of Dr. Loutrel's testimony rejecting this contention, TR. 1-96-97, the court finds Spalding's position without merit.

B. *The Tri-hollow Racket*

Spalding had contended that the 9A triple-hollow extrusion cross-section is a design concept radically different from that of the patent in suit which departs significantly from the original LBA cross-section, as well as the Spalding 5A and 6A cross-sections. Appendix D. Actually, a direct visual comparison between the 9A and 5A cross-section, as was carried out during the course of the trial by Dr. Loutrel, PX 53, 42, indicates that there are very few differences between the two tubular seamless cross-sections. Moreover, when the 9A extrusion is compared with the patent in suit, the evidence reveals that it infringes claims 1, 2 and 4 of the Latham-Brefka design.

The only readily discernible distinction between the 9A and the 5A is the hollowing out of the center web of the 5A extrusion to form a hollow core center web in the 9A extrusion. TR 1-63, TR. 1-119. The obviousness of this change was apparent as early as February 1968, when Peter Latham produced a sketch, of a tri-hollow extrusion for Paul Sullivan, PX 57, as a suggestion for improvements on LBA design to increase patent protection and anticipate future competition approaches. TR. 2-36-39; 4-63; PX 57; 68; AcroDynamics Industries drew a triple-hollow modification a few months later. PX 55. At the trial Dr. Loutrel, Dr. Kern, and Mr. Warner all testified that the change from a bi-hollow to a tri-hollow was straightforward engineering, not involving a fundamental revision of the original design. TR. 1-63, 119; 2-36; 4-132, 133; 5-103.

At Spalding, the 9A cross-section evolved directly from attempts to lighten and strengthen the 5A cross-section. All of these attempts involved removing material from the area near the neutral axes, first by narrowing the center web, and then by hollowing it out. TR. 1-107; PX 49; 50; 51; 52; 43.

From the performance standpoint, there is no difference between the 5A and the 9A tennis racket frames. In marketing rackets based upon the 5A and 9A cross-sections, Spalding made no distinctions to the purchasing public. Paul Sullivan, in testifying as to the playability characteristics between the 5A and 9A, commented:

> I kept interchanging them and trying to know which one was which. I still don't know which one was which, but I did not find any difference between the two.

TR. 2-140.

Spalding claims that the 9A does not infringe claims 1, 2 and 4 on two counts. The first distinction is the same as that advanced with respect to the 5A, *i.e.*, that the extrusion does not conform to the limitation that the

> exterior cross-section of the tube perpendicular to the stringing plane measured from the center of the extrusion to one end is significantly greater than the dimension of the tube parallel to the stringing plane measured across the web from one side of the extrusion to the other.

The other asserted difference is that the 9A does not have tubes interconnected by a web having a material thickness more than twice the wall thickness of the tubes.

Regarding the first contention, Spalding repeats its argument that the tube width includes the lip section, so that only the maximum width of the tube is meaningful. Accordingly, it says the language in the claim directing that the measurement be made across the web from one side of the extrusion to the other can safely be ignored. Dr. Loutrel testified, however, that the 9A extrusion meets this limitation of the claims and that the measurement of the tube dimension parallel to the stringing plane cross the web is appropriate. TR. 1-125, 126; TR. 2-31, 32. Even Dr. Kern, in responding to a direct question from the court, agreed

that a measurement of the dimension of the tube parallel to the stringing plane from one side of the 9A extrusion to the other across the interconnecting web could be made at a point on the diagram (as indicated by the arrows at .040 wall thickness) which would render the dimension significantly less than the dimension perpendicular to the stringing plane. TR. 6-49.

The second limitation which Spalding contends the 9A extrusion fails to meet, is that the 9A does not include an "interconnecting web having a material thickness more than twice the wall thickness of the tubes." Spalding argues that the hollowed out center section interconnecting the two outer tubes is not a "web", but is rather a "third tube" or, perhaps, a pair of webs interconnecting the outer tubes. Yet, Dr. Loutrel, in reading the term "web" in light of the specifications and file history, *see United States* v. *Adams*, 383 U.S. 39, 49 (1966), noted that it clearly covered the hollowed outer center web of the 9A extrusion. TR. 2-5, 6. Spalding's engineering expert, Dr. Kern, also appeared to agree when he stated in answer to questions put to him by defense counsel:

> Q. Doctor, would you step down now and indicate to the court what you have put on Exhibits SS and TT and the purpose of it?
>
> A. Yes. I've put on arrows across the cross-section shown as Spalding 9-A where the two interconnecting metal portions that go between the upper and lower tubes connect to the upper tube, and I feel that those arrows are in a place where they would measure an exterior cross-sectional dimension of the tube where it connects to the interconnecting webs or *web, if we want to consider the removal of material doesn't change substantially the function of interconnecting the two tubes.*

TR. 6-59. (emphasis added).

Dr. Loutrel also found that the interconnecting web in the 9A has a material thickness more than twice the wall thickness of the tubes. He explained that the requirement is that the inner walls of the extrusion have a continuous material support connecting them in the direction parallel to the stringing plane to prevent collapse both from the load placed on the extrusion by the strings and during bending of the racket during manufacture. Unless the extrusion were to have the collapsed tube structure similar to LaCoste, therefore, additional material must be connecting the two wall thicknesses and hence the total amount of material must exceed twice the wall thickness. TR. 1-123; 2-8, 11. Thus, in the 9A, it is the length of the supporting struts that provides a material thickness in the horizontal direction more than twice the wall thickness of the tubes.

Defendant's witnesses, Messrs. Long and Maxwell, also testified that support against collapse is provided by the interconnecting webs and struts. PX 99-46, 58; 707-100, 101.

Even if the term "interconnecting web" cannot literally be read on the hollowed outer center web section of the 9A extrusion, it is clear that this tennis racket frame still infringes claims 1, 2 and 4 of the patent in suit under the doctrine of equivalents.

At the trial, Dr. Loutrel testified that the hollowed out center web of the 9A extrusion racket performs the same function in the same way as the center web of the 5A extrusion racket and that the removal of material did not change the function. TR. 1-122, 124.

Mr. Maxwell, the Defendant's witness, testified on the trihollow as follows:

> Q. What are the purposes of the internal supports shown there?
>
> A. One is a grommet guide and two is a strengthening rib to support the inner wall.
>
> Q. Does it perform the same function in strengthen-

ing the inner and outer wall as the center web in the 6-A [sic] bi-hollow?

A. Yes.

PX 99-57; 58.

Thus, infringement by the tri-hollow racket of claims 1, 2 and 4 may be found on the basis of literal infringement of the claims or on the basis of the doctrine of equivalents.

IV.

Fraud

Spalding argues that even if the patent is valid on its face, it is unenforceable because of fraud on the patent office. Spalding has alleged that Sullivan practiced fraud on the Patent Office in the prosecution of the application in suit, alleging as misrepresentations and omissions: (1) the claim in the Latham affidavit that it was not until after many months of struggling with the problem that he and the inventor Brefka hit upon using the double-hollow extrusion disclosed and claimed in this application; (2) a claim in the affidavit of Paul Sullivan that Pancho Gonzales successfully used a racket based upon the patent in suit; (3) the use of discrepancies in the "Knepp Caculations" and, (4) the concealing of the existence of Dr. Glaser. The evidence which Spalding cites in support of these charges, falls far short of the clear and convincing proof of wrongfulness, willfulness or bad faith, which is necessary to sustain a claim of fraud on the Patent Office. *See Bendix* v. *Balax,* 421 F.2d 809 (7th Cir.), *cert. denied,* 399 U.S. 911 (1970); *Xerox Corporation* v. *Dennison Manufacturing Co.,* 322 F. Supp. 963 (S.D. N.Y. 1971).

The first claim of fraud relates to the second paragraph of Peter Latham's affidavit submitted to the Patent Office in January 1968. PX 2-52. It reads:

> When he [sic] first considered building an aluminum tennis racket, he was quite familiar with the subject matter of LaCoste patent number 3,086,777 and the

> obvious approach to him to try was to make a tennis racket frame from a solid extruded aluminum extrusion. This produced an unsatisfactory racket from the standpoint of strength, weight and playability considerations. *It was not until after many months of struggling with the problem that he and inventor Brefka hit upon using the double hollow extrusion disclosed and claimed in this application.* (emphasis supplied).

It is Spalding's contention that in this paragraph Latham is making the claim that he spent several months struggling with the problem of developing a high quality tennis racket *after* abandoning the solid I-beam rackets. Read in this way, Spalding argues, the statement is patently false because Dr. Glaser of Reynolds Aluminum was the person who "hit upon" the idea of using the double hollow extrusion and that this was done in the course of one afternoon in November 1967. The argument has no merit for, as has already been shown, the evidence of Dr. Glaser's putative inventorship, is uncorroborated at best. Moreover, the Latham affidavit itself is open to at least one other interpretation: *i.e.,* that Latham and Brefka struggled with the entire problem of developing a satisfactory racket from the initial conception of the project in mid-summer 1967 until well into 1968, a reading which is also borne out by the evidence.

The second claim of fraud is based on the statement in Paul Sullivan's affidavit in support of the application, PX 2-30, that Pancho Gonzales and Bob Lutz successfully used the racket based on the patent in suit. Spalding argues that this statement is false because (1) the rackets which Gonzales and Lutz used were based on the fundamental Spalding changes in the patent in suit and (2) that the original LBA rackets were failures. In light of this court's holding that the Spalding 5A, 6A and 9A cross-sections were merely

modifications of the original patent in suit, Paul Sullivan's statement, while perhaps a bit grand, could hardly be termed fraudulent. Nor could the "failure" of the whack test serve as a basis for finding this statement fraudulent. The results of the whack test did not deter Spalding from accepting the racket and it was even criticized by Dr. Glaser since it involved a makeshift procedure that provided stress to only on one side of the racket. DX FFF-72, 73.

The Knepp calculations refer to calculations submitted by Latham and Brefka by a structural engineer, Morris Knepp, PX 2-68-72, to show that figure 7 of the LaCoste patent was weaker than the patent in suit. Knepp claimed to make his calculations using cross sections of the LaCoste and LBA patents of the same size, PX 2-70, figures 3 and 4; TR. 5-79-81; 6-3-5, yet when the calculations were actually made, Spalding claims Knepp used a figure for the width of the patent in suit that was larger than the comparable figure for LaCoste. Spalding argues that if the measured cross-sections were in fact equal, the LaCoste configuration would actually be the stronger, rather than the weaker, of the two.

The materials making up the Knepp calculations consist of three pages in the wrapper, PX 2-70-72. The first page, PX 2-70, consists of four drawings of various extrusions, the third and fourth drawings being LaCoste and LBA respectively. The second and third pages of the calculations, PX 2-71-72, consist of mathematical equations which are presumably based on the four drawings which precede them. The dimensions for LaCoste and LBA, appearing at PX 2-70, and interpreted by Dr. Kern, TR. 6-4, list the radius of the LaCoste extrusion as .140 inches, giving it a .280 inch diameter, and the width of the LBA extrusion as .280 inches. There is no indication in the figures that follow that any other dimensions were used by Knepp to arrive at his conclusions.

The defendant argues that a careful dissection of the entire Knepp report, including the equations on the second and third pages, reveals the cross-section dimensions of the two extrusions used there were different. Yet the equations certainly do not speak for themselves on this point and there is no expert testimony which explains the *basis* for the defendant's position. TR 5-80. In view of the complexity of the calculations, the record simply lacks evidence of the clear and convincing nature necessary to show fraud.

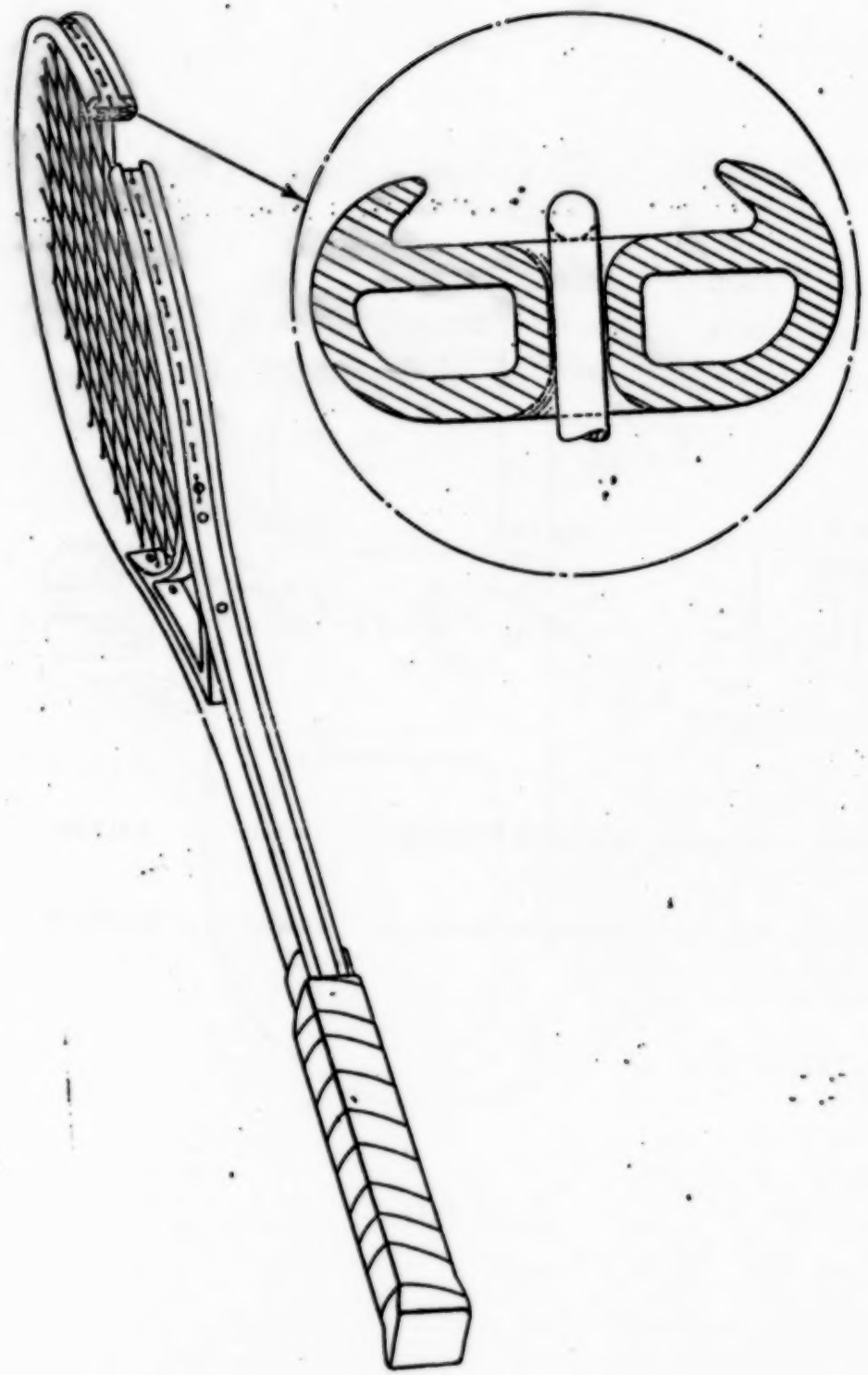
Finally, even assuming arguendo that the plaintiff "hid" Dr. Glaser from the patent Office, absent clear and convincing evidence that it was he who first hit upon using bi-hollow extrusions, the court cannot say that the plaintiff's action in this regard was fraudulent.

In conclusion, this court holds that

(1) the claims of patent in suit valid, and

(2) Spalding's production and sale of the Smasher racket based on its modifications of the patented design constitutes infringement of certain of those claims.

(s) J. L. Tauro
United States District Judge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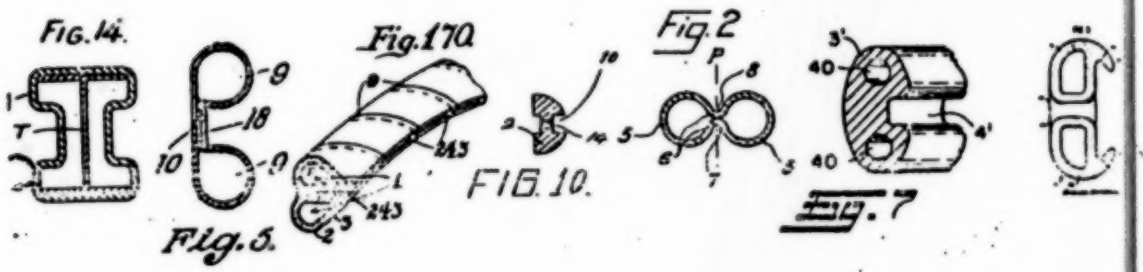
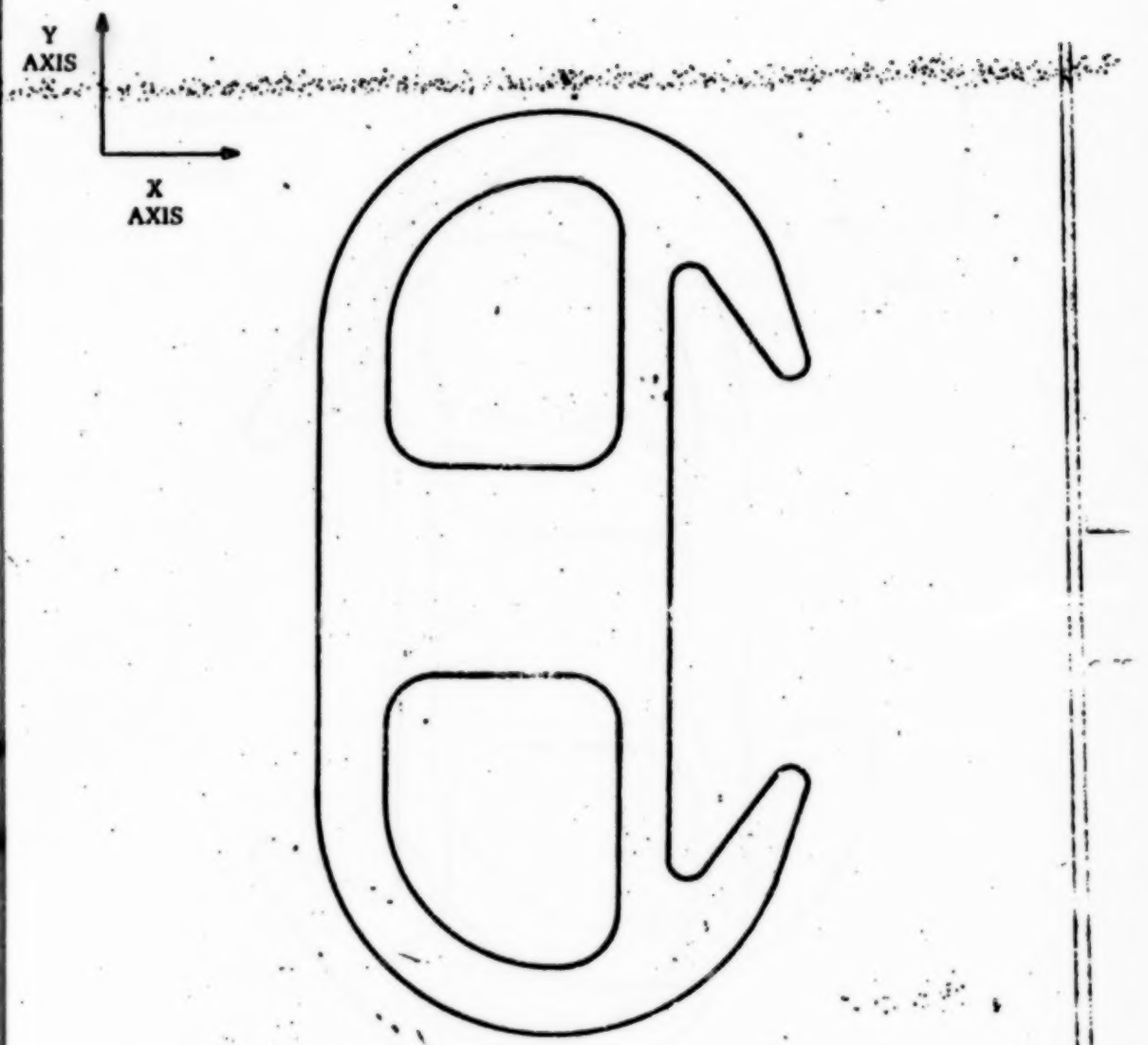


HARRIS	BRITISH	ROBINSON	TAKAHASHI	LaCOSTE	PALMER	LATHAM ET AL
#1,452,803	#522,222	#2,593,714	#3,083,968	#3,086,777	#3,540,728	#3,625,5



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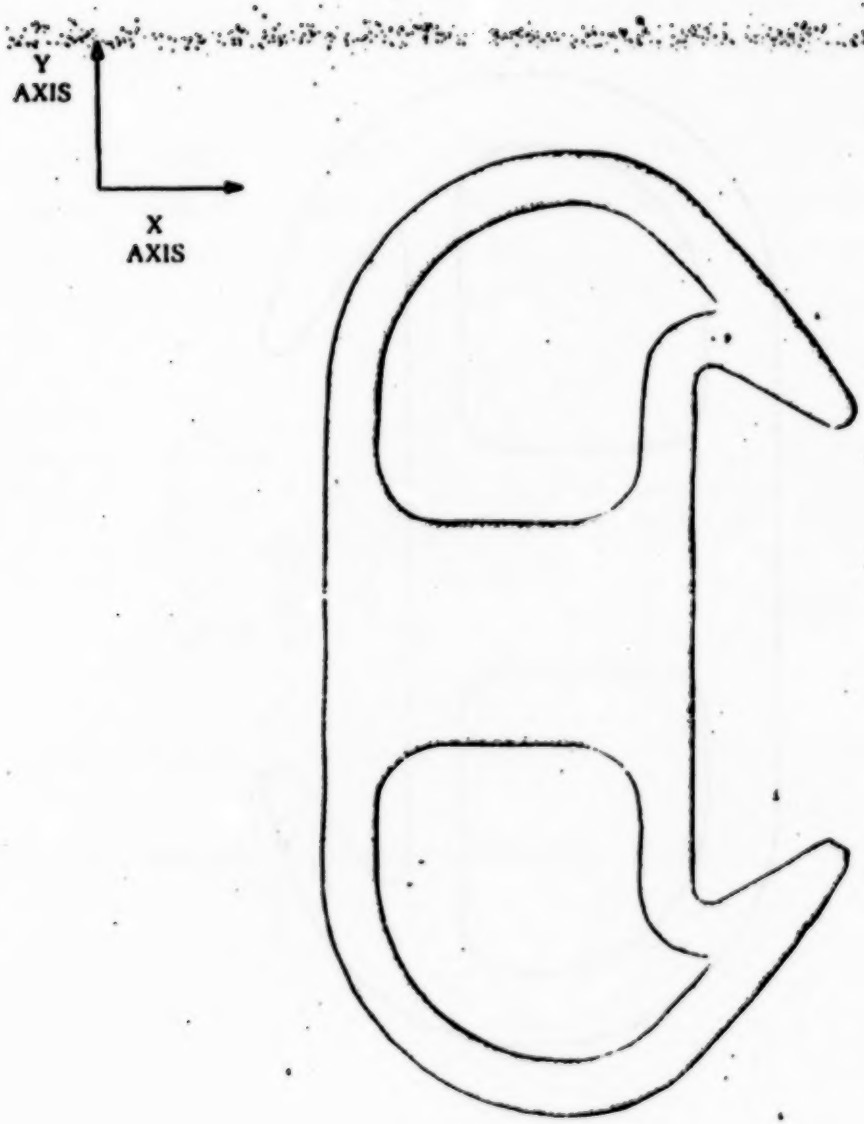

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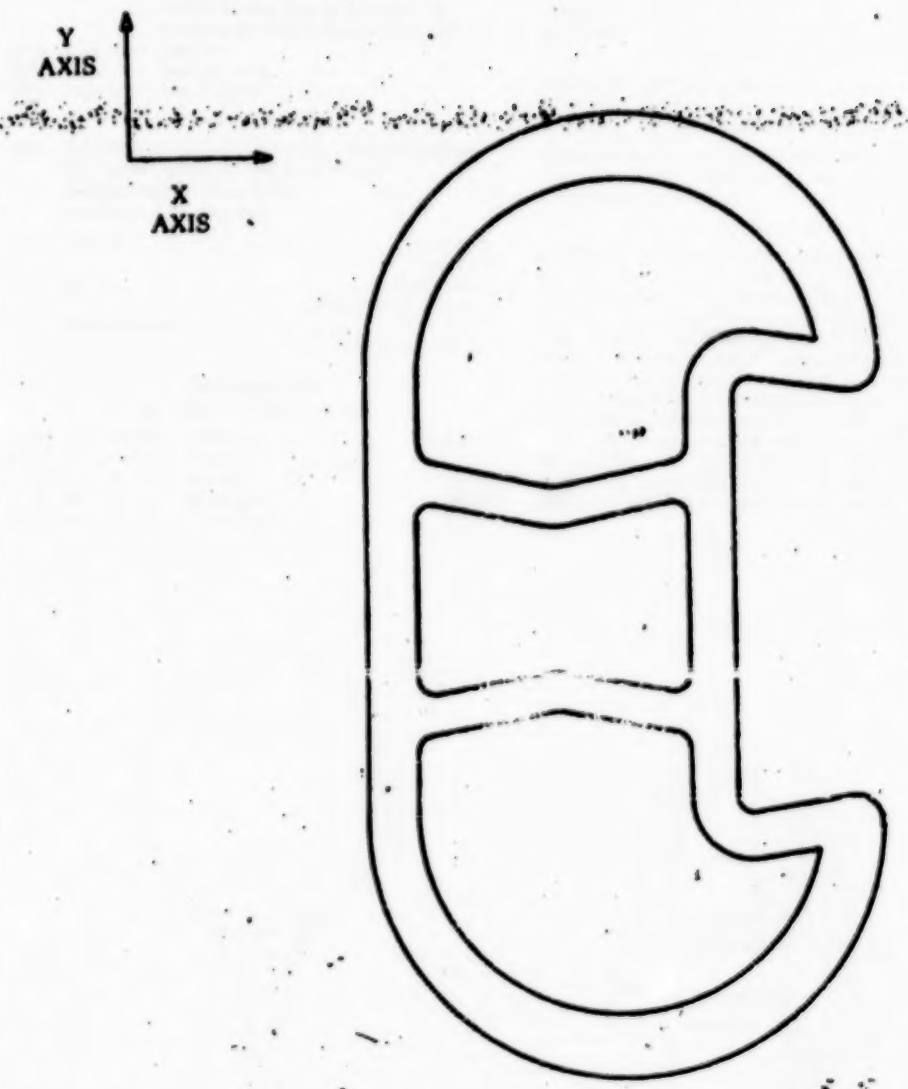

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PLAINTIFF'S EXHIBIT No. 1

PLAINTIFF'S EXHIBIT

United States Patent

(11) 3,625,512

(72) Inventors: Peter A. Latham;
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Commercial Wharf, Boston, Mass. 02110

(21) Appl. No. 700,776
(22) Filed Jan. 26, 1968
(45) Patented Dec. 7, 1971

(54) EXTRUDED RACKET HAVING TWO SEAMLESS HOLLOW TUBES FORMED WITH AN INTERCONNECTING WEB

13 Claims, 3 Drawing Figs.

(52) U.S. Cl. ..... 273/73 C, 273/73 H
(51) Int. Cl. A63b 49/02, A63b 49/04, A63b 49/12
(50) Field of Search 273/73, 73.1, 73.3, 73.4, 73.6, 73.8

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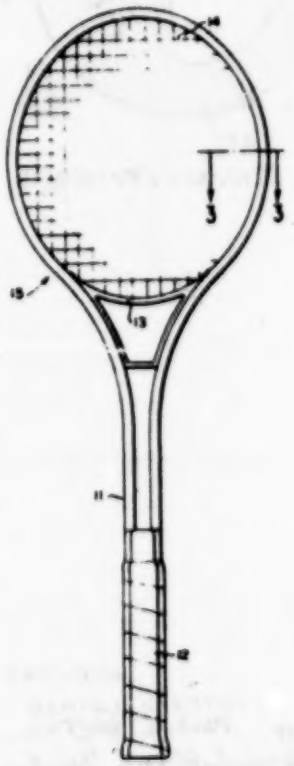
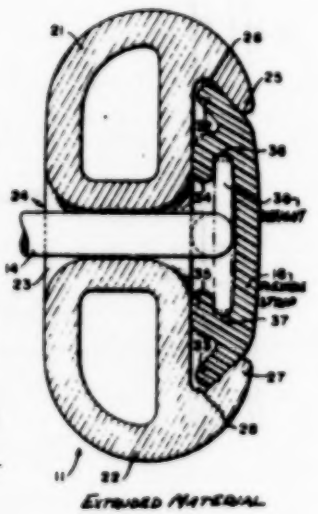
Primary Examiner—Richard C. Pinkham
Assistant Examiner—Richard J. Apley
Attorney—Charles Hieken

ABSTRACT: A racket is made of an aluminum extrusion having two seamless hollow tubes formed with a web of thickness that is more than twice the wall thickness of each tube and is drilled at intervals for receiving the racket strings. The cross-sectional dimension of the extruded racket in a direction perpendicular to the stringing plane is greater than the dimension parallel to the stringing plane. The outside portion of the extrusion is formed with upper and lower grooves for receiving a strip of flexible material that functions for improved balance and weight control and protecting the strings from abrasion, dirt and moisture. The flexible strip may function to help balance and control the weight of the racket through its own weight, supplemented, if necessary, by weights that it may carry.





PATENTED DEC 7 1971

3,625,512

FIG. 1

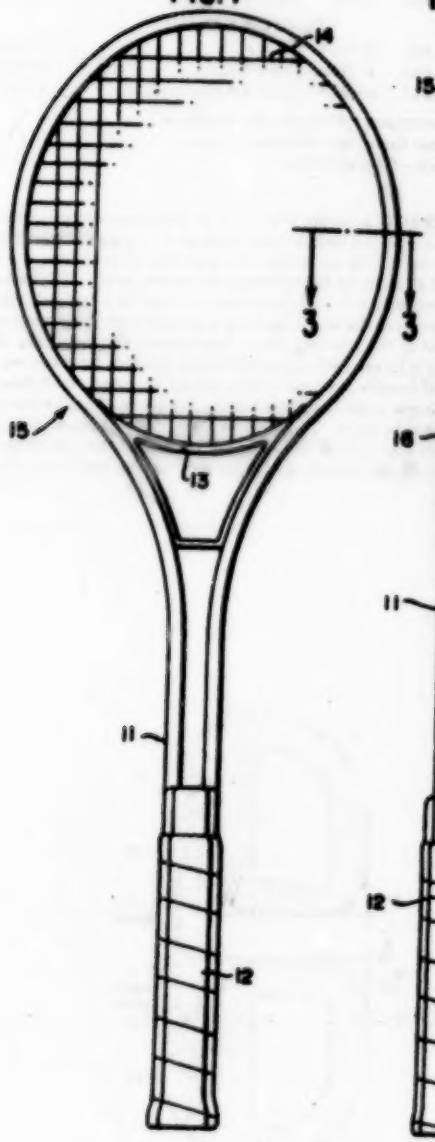
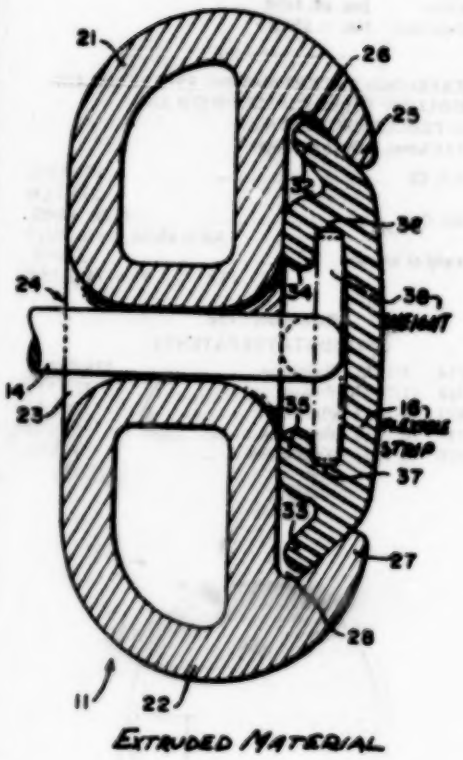


FIG. 2

FIG. 3



INVENTORS
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PAUL E. BREFKA
BY Wolf, Greenfield and Hieken
ATTORNEYS

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,625,512 Dated December 7, 1971

Inventor(s) Peter A. Latham & Paul E. Brefka

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 9, after "end", insert -- than --.

Column 4, line 34, change "22" to -- 1 --.

Signed and sealed this 6th day of March 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

EXTRUDED RACKET HAVING TWO SEAMLESS HOLLOW TUBES FORMED WITH AN INTERCONNECTING WEB

BACKGROUND OF THE INVENTION

The present invention relates in general to rackets and more particularly concerns a novel extruded racket that is relatively easy and inexpensive to construct, facilitates maintaining exceptionally high tension on the racket strings to a desired level without damaging the strings, facilitates achieving proper balance and helps protect the strings from damage caused by abrasion, moisture or dirt where the string is connected to the racket frame.

It is an important object of this invention to provide an improved racket.

It is another object of the invention to provide a sturdy racket that may be economically and relatively easily constructed from extruded material.

It is a further object of the invention to achieve one or more of the preceding objects while maintaining strings in high tension.

It is a further object of the invention to provide a better playing racket.

It is a further object of the invention to achieve one or more of the preceding objects while establishing a desired control over the racket balance and weight.

It is a further object of the invention to achieve one or more of the preceding objects while providing a protective covering for the strings near the outside perimeter of the racket head to minimize damage from abrasion, moisture or dirt while helping to balance the racket and providing a distinctive and attractive appearance.

It is still further object of the invention to achieve the preceding object while providing a means for supporting supplementary balancing weights, allowing easy adjustment of weight and balance by the player.

SUMMARY OF THE INVENTION

According to the invention, a racket includes a frame-supporting handle means and defining head means supporting racket strings. The frame is formed with means for receiving a flexible strip for both balancing the racket and controlling the weight in a predetermined manner and protecting the strings from damage by abrasion, moisture or dirt.

A feature of the invention is the forming of extrusion into racket shape, the extrusion having two hollow portions that are seamless tubes formed with a solid interconnecting web formed with rounded openings along at least a predetermined portion of its length corresponding to the head means at intervals for receiving racket strings. Preferably the separation between the seamless tubes is greater than the wall thickness of each tube. Preferably the means in the web defining the opening is rounded to smoothly accommodate the racket string threaded among the holes without imposing any sharp edges on the string that might weaken the string when under tension. The result is a racket that is less flexible for better playing control and facilitates establishing an exceptionally high level of tension in the strings without damaging the strings.

Preferably the extrusion is also formed with grooves along its outer perimeter separated by the interconnecting web for receiving a flexible strip that functions for balance and weight control and to protect the strings from abrasion, moisture or dirt and help achieve a desired degree of balance for the racket. The flexible strip may also accommodate additional supplemental weights.

Numerous other features, objects and advantages of the invention will become apparent from the following specification when read in connection with the accompanying drawing in which:

FIG. 1 is a plan view of a racket according to the invention;

FIG. 2 is a side view of a racket according to the invention; and

FIG. 3 is a sectional view through section 3—3 of FIG. 1 to illustrate the preferred form of the extrusion cross section comprising the racket frame.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference now to the drawing and more particularly FIG. 1 thereof, there is shown a plan view of a metal tennis racket according to the invention. The racket comprises an aluminum extrusion 11 formed in the shape of a racket that supports a handle 12, a yoke 13 and strings 14. Yoke 13 is typically riveted to frame 11 to help establish the desired shape and dimensions of the head 15 carrying the strings 14. Yoke 13 may be an aluminum casting appropriately drilled in its sides for accommodating the securing rivets and along its top for receiving the lower ends of the vertical ones of strings 14.

Referring to FIG. 2, there is shown a side view of a metal racket according to the invention in which the flexible strip 16 is visible. The flexible strip 16 functions to protect the strings from abrasion, dirt or moisture, to help achieve a desired degree of balance of the racket and to provide a distinctive attractive appearance to the racket.

Referring to FIG. 3, there is shown an enlarged sectional view through section 3—3 of FIG. 1 illustrating the cross section of the extrusion through an opening accommodating a racket string together with the relationship of the flexible strip and supplemental weights. The extrusion 11 is a unitary structure having a hollow upper portion or seamless tube 21, a hollow lower portion or seamless tube 22 and a solid interconnecting web 23 that may be described as a unitary structure having two seamless hollow tubes 21 and 22 formed with a solid interconnecting web 23 of solid material thickness that is more than twice the wall thickness of each tube. The string opening 24 is preferably rounded as shown so that the strings are never exposed to a sharp edge that might stress the string.

The cross sectional dimension of the extrusion perpendicular to the stringing plane defined by strings 14 is greater than the dimension of the extrusion parallel to the stringing plane. The exterior cross-sectional dimension of each of the two seamless hollow tubes is significantly greater in the direction perpendicular to the stringing plane measured from the center of the extrusion to each end than in the direction parallel to the stringing plane measured across the interconnecting web from one side of the extrusion to the other with each of the tubes having an internal hollow with a shape substantially corresponding to the exterior shape of the tube with the wall thickness of each tube thus being formed therebetween being substantially constant. The dimensions of each internal hollow perpendicular and parallel to the stringing plane are greater than the tube wall thickness. Each of the hollows is generally rectangular with length and width respectively perpendicular and parallel to the stringing plane and one corner away from the stringing plane having a radius of curvature much greater than that at the other corners.

The extrusion is formed into the racket shape having the curved head frame 15, the handle extension and the throat in between as best seen in FIG. 1.

The separation between hollows is greater than the wall thickness of the first tube added to the wall thickness of the second tube, and the interconnecting web is formed with rounded openings 24 along at least the curved head frame for receiving the game racket strings 14 with the separation between adjacent ones of the openings such as 24 corresponding to the separation between adjacent strings 14 when the frame is strung.

Upper hollow portion 21 is also formed with an outwardly and downwardly extending lip 25 to define an upper groove 26. Lower hollow portion 22 is formed with an upwardly and outwardly extending lip 27 to define a lower groove 28.

The lips extend outwardly from the racket shape from portions of each of the tubes nearer to the ends of the extrusion away from the stringing plane than to the stringing plane.

Upper groove 26 and lower groove 28 function to accommodate flexible strip 16 having an upwardly and inwardly extending lip 32 for engagement inside of lip 25 and a downwardly and inwardly extending lip 33 for engagement with lip 27. In addition flexible strip 16 may be formed with a downwardly extending inside lip 34 and an upwardly extending inside lip 35 that define an upper groove 36 and lower groove 37, respectively. The grooves 36 and 37 function to accommodate diclike weights, such as 38, between the strings for providing a desired degree of racket balance. A string 14 is shown in position of diameter corresponding substantially to the narrowest diameter of opening 24. Opening 24 may, if desired, be made large enough to accommodate two strings if it is desired that a particular opening accommodate both a vertically extending and a horizontally extending string. It is, however, preferred that each opening accommodate only a single string, and that, if necessary, separate openings be drilled for vertical strings and separate ones for horizontal strings. For reasons of economy one hole size is preferred of diameter large enough to accept three strings. As is apparent from FIG. 1, the openings are along the head portion of the frame with the separation between adjacent openings corresponding to the separation between adjacent strings.

The particular structure of the flexible strip 31 has a number of advantages. The lips 32–35 coact to firmly keep the flexible strip 31 in a desired position. At the same time lips 33 and 34 perform the additional function of helping to define grooves 36 and 37 for accommodating supplemental weights, if desired. If the density and/or cross-sectional area of flexible strip 31 is appropriately chosen to achieve a predetermined weight per unit length, a desired degree of balance may be obtained without using supplemental weights 38. However, an individual player may desire a different degree of balance and weight which may easily be achieved by inserting an appropriate number of supplemental weights in appropriate positions. The racket is ordinarily preferably balanced so that it is balanced about a line generally perpendicular to the racket length and passing along the bottom web of the yoke 13.

In a specific embodiment of the invention, the diameter of the neck of opening 24 was 0.1 inch and the radius of curvature, 0.062 inches. The height of extrusion 11 was 0.68 inches and its width 0.312 inches. The separation between lips 25 and 27 was 0.368 inches. The span of lips 25 and 27 from the nearest vertical wall was 0.092 inch. The width of each opening in hollow sections 21 and 22 was 0.120 inches, the typical wall thickness being 0.05 inches and slightly narrower where curved adjacent to opening 24. Extrusion 38 was made of black rubber. Weight 38 was a copper or lead weight.

In a preferred form of making the invention, the extrusion is first formed in a flat length, cut to length and then openings like opening 24 drilled with a radius drill. Then the length of extrusion is formed into the racket frame shape and yoke 13 riveted in place. Handle 12 may then be attached, and the racket strung. Then plastic strip 31 may be inserted in place with supplementary weights, if any, appropriately positioned.

The invention has a number of advantages. It is strong, light, economical to fabricate, withstands rugged use, maintains a desired high degree of tension in the strings and is well balanced. It is evident that those skilled in the art may now make numerous modifications of and departures from the specific embodiments described herein without departing from the inventive concepts. Consequently, the invention is to be construed as embracing each and every novel feature present in or possessed by the apparatus and techniques herein disclosed and limited solely by the spirit and scope of the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed, are defined as follows:

1. A game racket frame for stringing comprising,

an aluminum extrusion that is a unitary structure having two seamless hollow tubes formed with an interconnecting web of material thickness that is more than twice the wall thickness of each tube,

the cross-sectional dimension of said extrusion perpendicular to the stringing plane being greater than the dimension of the extrusion parallel to the stringing plane,

the exterior cross-sectional dimension of each of said tubes being significantly greater in the direction perpendicular to the stringing plane measured from the center of said extrusion to each end in the direction parallel to the stringing plane measured across said interconnecting web from one side of the extrusion to the other,

each of said tubes having an internal hollow with a shape substantially corresponding to the exterior shape of the tube with the said wall thickness thus being formed therebetween being substantially constant,

the dimensions of said internal hollows perpendicular and parallel to said stringing plane being greater than said tube wall thickness,

said extrusion being formed into a racket shape having a curved head frame, throat and handle extension.

2. A game racket frame for stringing in accordance with claim 1 wherein the separation between the internal hollows of said tubes is greater than the wall thickness of the first of said tubes added to the wall thickness of the second of said tubes,

and said interconnecting web is formed with rounded openings along at least a predetermined intermediate portion of its length corresponding to said curved head frame for receiving game racket strings with the separation between adjacent ones of said openings corresponding to the separation between adjacent strings when said frame is strung.

3. A game racket for stringing in accordance with claim 22 wherein said shape of said hollows is generally rectangular with length and width respectively perpendicular and parallel to said stringing plane and one corner away from the stringing plane having a radius of curvature much greater than that at the other corners thereof.

4. A game racket extrusion for stringing in accordance with claim 1 wherein said extrusion is formed with lips extending outwardly of the racket shape from portions of each of said tubes nearer to the ends of said extrusion away from said stringing plane than to said stringing plane.

5. A game racket frame in accordance with claim 1 where the thickness of said web corresponds substantially to the width of said tubes.

6. A game racket frame in accordance with claim 1 wherein said extrusion is formed with means for receiving a flexible strip,

said frame being formed for supporting handle means and defining head means for supporting strings,

a flexible strip carried by said means for receiving about the perimeter of said head means and coacting with same frame to comprise means for balancing and controlling the weight of said racket and for protecting the racket strings from damage by abrasion, moisture or dirt.

7. A game racket frame in accordance with claim 6 wherein said extrusion is also formed with grooves along its outer perimeter separated by said interconnecting web comprising said means for receiving,

said flexible strip residing in said grooves.

8. A game racket frame in accordance with claim 6 wherein said flexible strip is formed with means for removably supporting elemental weights.

9. A game racket frame in accordance with claim 8 and further comprising at least one of said elemental weights carried by said means for removably supporting.

10. A method of making the game racket frame of claim 1 which method includes the steps of,

forming said extrusion,

drilling said rounded openings in said web along said predetermined intermediate portion of its length.

and forming said extrusion into the shape of a racket having a head portion embracing said predetermined intermediate portion of the web length and a handle portion for supporting handle means.

11. A method of making a game racket frame in accordance with claim 10 and further including the step of,

fastening opposed portions of said extrusion to a yoke along substantially the boundary between said handle portion and said head portion.

12. A method of making a game racket in accordance with claim 11 and further including the step of forming said extrusion with grooves along its outer perimeter separated by said interconnecting web,

and inserting a flexible strip in the latter grooves.

13. A method of making a game racket in accordance with claim 11 and further including the steps of,

forming said extrusion with grooves along its outer perimeter separated by said interconnecting web,

inserting supplemental weights in a flexible strip,

and inserting said flexible strip carrying said supplemental weights in the latter grooves.

* * * * *

PLAINTIFF'S EXHIBIT No. 7

United States Patent

[11] 3,540,728

[72] Inventor George R. Palmer
19044 Gusbo Drive, Fairview Park, Ohio 44126

[21] Appl. No. 681,426
[22] Filed Nov. 8, 1967
[45] Patented Nov. 17, 1970

[54] RACKET WITH METAL FRAME WELDED TO HANDLE SLEEVE
10 Claims, 9 Drawing Figs.

[52] U.S. Cl. 273/73
[51] Int. Cl. A63b 59/00
[50] Field of Search 273/73, 73.4, 73.8, 73.9, 75

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Primary Examiner—Richard C. Pinkham
Assistant Examiner—Richard J. Apley
Attorney—Oberlin, Maky, Donnelly & Renner

ABSTRACT: A racket having an extruded metal frame with string holes in the bow whose ends are coined or forged to provide smooth rounded shoulders which preclude string damage and wear. A continuous groove in the outer periphery of the frame contains the portions of the strings passing between the holes to prevent damage thereto by contact with external surfaces. The frame has two parallel spaced handle extensions which extend into a handle sleeve. At each end of the handle sleeve is a metal plate which has two opposite edge notches to receive the handle extensions. The end plates are welded to the handle extensions and to the handle sleeve.

Fig. 1

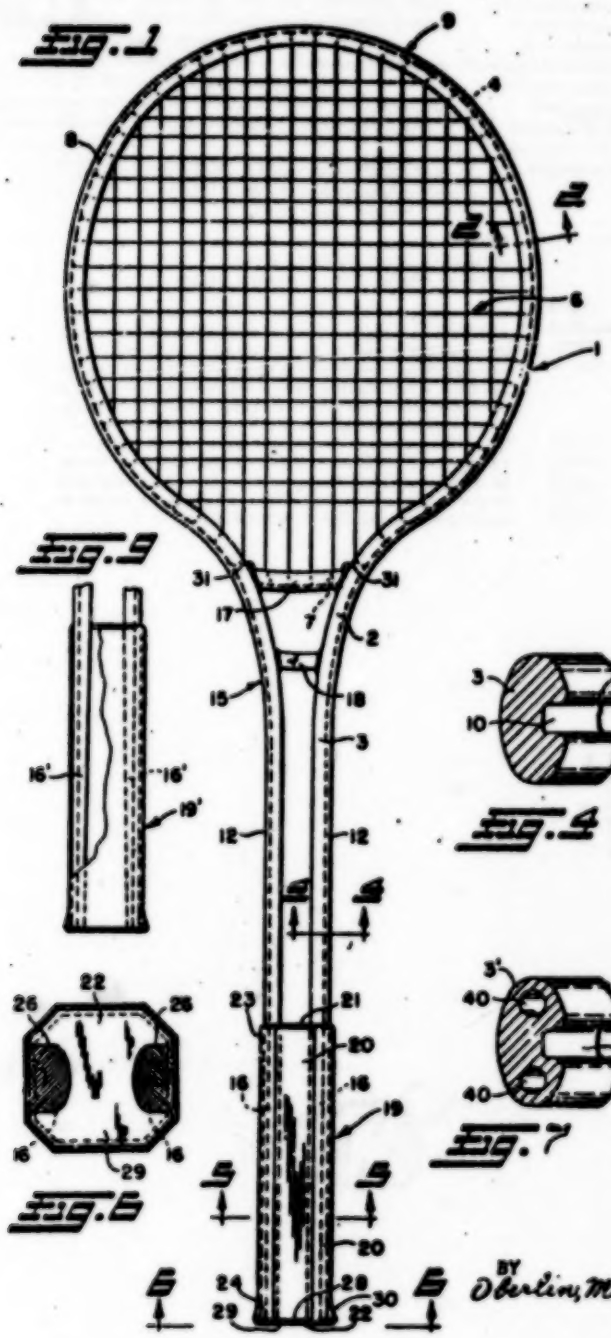

Fig. 2

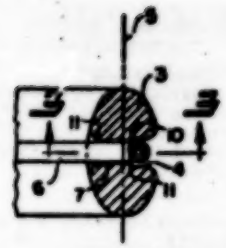

Fig. 3

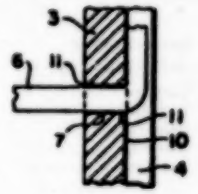

Fig. 4

Fig. 5

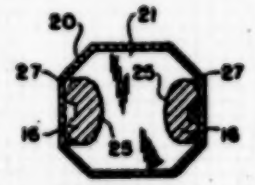

Fig. 6

Fig. 7

Fig. 8

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1

RACKET WITH METAL FRAME WELDED TO HANDLE SLEEVE

BACKGROUND OF THE INVENTION

This invention relates generally as indicated to a racket and more particularly to certain improvements in rackets for use in playing tennis, badminton, squash, paddle ball, and other such games.

Those who have some familiarity with the modern day wooden tennis racket know that the bow is very susceptible to warping which if severe enough makes the racket totally useless, and in any event substantially affects the tension of the strings. The wooden racket is also easily marred and may even break especially if abused as it oftentimes is by the frustrated amateur. Accordingly, there is a definite need for a racket made of a much more durable material that does not warp such as metal, but the problems inherent in the use of metal for rackets have not very satisfactorily been overcome, as evidenced by the general acceptance of the wooden racket.

Metals are as a rule much heavier than wood, so much so in fact that the weight of the racket often becomes a problem when metal is used, and there is always the danger of a sharp corner cutting or damaging the strings. Another problem which has plagued racket manufacturers is how to attach the handle of the racket to a metal frame in such a manner that it will be sufficiently strong to withstand the high shock loads during play and yet not add too much to the weight of the racket. Variations in the weight of the racket must also be possible without substantially affecting its strength to permit use by men, women, or children.

In recent years, there have been considerable strides in making metal rackets which are light enough to be within the prescribed weight ranges, and ways have been found to prevent damage to the strings, but only by stringing the racket in an unorthodox manner not at all like conventional stringing. Ways have also been devised for attaching the handle to the metal frame, but for one reason or another none have proven to be entirely satisfactory.

SUMMARY OF THE INVENTION

With the foregoing in mind, it is a principal object of this invention to provide a racket generally of the type described which may be made out of metal to substantially eliminate warping and breakage, and may be strung in conventional manner without fear of string damage.

Yet another object is to provide a metal racket which may be formed in a simple and economical manner and be of any prescribed weight.

Still another object is to provide such a racket with a groove around the entire outer periphery of the bow to protect the strings against damage.

A further object is to provide a racket of the type described with a very strong, lightweight handle.

These and other objects are achieved by making the frame of the racket out of a continuous piece of metal, preferably extruded, with a groove in one side which provides a weight reducing channel around the entire outer periphery of the frame when bent to shape and receives the strings passing from one string hole to another for protecting the same against damage by external forces. The string holes are coined or forged at both ends prior to bending the metal strip into shape to provide smooth rounded shoulders which prevent string damage and wear, and the handle is welded at both ends to the frame to provide a strong, lightweight construction.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWING

In the annexed drawing:

2

FIG. 1 is a plan view of a preferred form of racket constructed in accordance with this invention;

FIG. 2 is an enlarged transverse section through one of the string holes in the bow of the racket of FIG. 1, taken on the plane of the line 2–2 thereof;

FIG. 3 is an enlarged fragmentary longitudinal section along the groove in the outer periphery of the bow, taken along the plane of the line 3–3, FIG. 2;

FIG. 4 is an enlarged transverse section through a portion of the frame of FIG. 1 in the region of the throat;

FIG. 5 is an enlarged transverse section through the handle of FIG. 1 taken on the plane of the line 5–5 thereof;

FIG. 6 is an enlarged end elevation view of the outer end of the handle as seen from the plane of the line 6–6, FIG. 1;

FIGS. 7 and 8 are enlarged transverse sections similar to FIG. 4, but showing other configurations for the metal frame to reduce the weight of the racket; and

FIG. 9 is a plan view another form of handle for use with the racket of FIG. 1, partially broken away to show the tapering of the throat extensions to reduce the weight of the racket.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in detail to the drawings and first especially to FIG. 1, there is shown by way of example a tennis or similar type racket 1 the frame 2 of which has been formed by bending to shape a continuous strip 3 desirably having a generally uniform solid section throughout its length. Although various metals and nonmetals such as magnesium, steel, fiberglass, plastic, or wood may be used to make the frame 2 depending upon the weight and strength requirements and other factors to be later discussed, it has been found that aluminum provides a very high strength, lightweight frame which may be easily extruded into the desired elliptical cross-sectional shape shown in FIG. 2 with a longitudinal groove 4 in one side. A plane 5 passing through the foci of the elliptical section is perpendicular to the plane of the strings 6, thus providing a truly aerodynamic-shaped frame in the direction of ball strike for maximum efficiency and minimum air resistance.

To facilitate stringing of the frame 2, holes 7 are drilled or otherwise machined in the extruded metal strip 3 in the central region 8 thereof which will constitute the bow 9 prior to shaping the frame and while the strip 3 is in a substantially perfectly flat condition. The holes 7 are formed perpendicular to the bottom 10 of the longitudinal groove 5, after which the burrs are removed in conventional manner and the ends of the holes 7 are coined or forged to provide smooth, rounded shoulders 11 at each end, whereby strings 6 of gut, nylon, or other suitable material may be used without fear of being damaged by sharp corners.

After the holes 7 have been properly coined or forged, the elongated strip 3 is bent into the final desired shape using a press brake or suitable dies. When thus formed, the central region 8 of the metal strip 3 constitutes the bow 9 as aforesaid, whereas the ends 12 of the strip 3 extend from the bow 9 in parallel closely spaced relation to provide the throat 15 and handle extensions 16 for the frame. A bridging element 17 preferably of the same material as the metal strip 3 and having string holes 7 formed therein with the ends of the holes coined to provide rounded shoulders is welded in conventional manner between the ends of the central region 8 to complete the bow 9, and a similar bridging element 18 without holes may be welded between the strip ends 12 somewhat spaced from the first bridging element 17 to provide a more rigid structure and more firmly transfer side loads on the racket to the handle. The strength of the frame 2 adjacent the welds will be reduced somewhat due to the elevated temperatures of the welding process, but it may be restored if necessary by conventional heat treating such as employed by the aircraft industry.

Attached to the handle extensions 16 is a handle 19 which preferably consists of a hollow one-piece thin metal sleeve 20 of hexagonal or other suitable shape telescoped over the handle extensions 16 which are in spaced apart relation within the

sleeve and secured thereto by welding end plates 21, 22 to the ends of the sleeve 20 around the entire periphery and welding the end plates 21, 22 to the handle extensions 16. As clearly shown in FIGS. 5 and 6, the end plates 21 and 22 are in the form of metal stampings having a configuration substantially identical to the ends 23, 24 of the tubular sleeve 20 which they abut, and are provided with a pair of notches 25 and 26 in opposite sides thereof which are of a shape generally corresponding to the shape of the handle extensions 16 to provide close mating engagement therewith. The tubular sleeve 20 and end plates 21, 22 are desirably of the same metal as the frame 2 to facilitate welding.

When welding the handle extensions 16 to the inner end plate 21, it is preferred that the clearance 27 between the handle extensions 16 and tubular sleeve 24 in the region of the notches 25 be completely filled with weld metal as shown in FIG. 5. The notches 26 in the outer end plate 22, on the other hand, are completely filled with weld metal, since the handle extensions 16 desirably extend only to the inner face 28 of the outer end plate 22 so that the weld metal may be made flush with the outer face 29 of the end plate 22 without having to remove any weld metal. This type of handle construction is very light in weight and extremely strong since it provides a torque box over the entire length of the handle. The outer end 24 of the tubular sleeve 20 may be flared outwardly as shown to provide a knob 30 at that end which when wrapped with a suitable leather, plastic, or rubber wrapping in conventional manner prevents the hand from sliding off of the handle during play. The size of the handle grip may be varied as by varying the size of the sleeve 20 or by varying the thickness of the grip material.

The frame 2 may now be strung in conventional manner by passing the strings 6 through the holes 7 in the bow 9 and bridging element 17 and tightening them either by hand or with the use of a conventional stringing machine without fear of damaging the strings, whether they be gut, nylon, or other suitable material, since there are no sharp corners at the ends of the holes which could damage the strings. The holes 7 through the outer ends of the bridging element 17 are at an angle to clear the weld connections 31. The portions of the strings 6 between the holes 7 are contained in the longitudinal groove 4 which extends around the entire outer periphery of the frame, whereby all of the strings 6 are protected against damage by external forces, and the weight of the frame 2 is reduced by the groove 4 without appreciably affecting the strength. For making the frame 2 lighter, the handle extensions 16' may be tapered 30 percent more or less toward their outer ends as shown in FIG. 9 without unduly weakening the handle 19', and an even greater reduction in the weight can be achieved by providing longitudinal holes 40 and 41 in the extruded strip 3' or 3'' with or without a second groove 42 running along the entire inner periphery of the frame, as shown in FIGS. 7 and 8. Otherwise the construction of the rackets of FIGS. 7—9 is substantially identical to that shown in FIG. 1.

A championship tennis racket can readily be obtained by making the frame 2 of extruded aluminum having the same cross-sectional configuration shown in FIG. 4, whereas a medium weight racket and a lady's racket may be obtained by using the extruded shapes of FIGS. 7 or 8 with holes therein and perhaps the additional groove 43 which also impart greater flexibility to the frame.

From the above discussion, it can be seen that the various features disclosed herein permit manufacturing a tennis racket out of extruded metals, preferably aluminum, which may be of any desired weight and strung in conventional manner without fear of damaging the strings. Such a metal racket is of a welded, unitized construction which is substantially warp proof, extremely strong, and can withstand considerable abuse without marring or in any other way damaging its appearance. When aluminum is used, the surface can be made even harder for greater resistance to scratching and marring by hard anodizing the metal, and the aluminum may also be color anodized to enhance its beauty.

Although the various principles of the present invention have been described primarily with reference to a tennis racket, it will be apparent that they have similar applications to other types of rackets as well, including badminton, squash, and paddle ball rackets, to name a few.

I claim:

1. A racket comprising a metal frame including a bow and a throat extending from said bow, said throat having a pair of handle extensions extending therefrom in closely spaced substantially parallel relation to each other, and a handle secure to said handle extensions, said handle comprising a one-piece hollow metal sleeve telescoped over said handle extensions which are in spaced apart relation within said sleeve, and metal end plates at the ends of said sleeve, said end plates having notches in opposite sides for said handle extensions, said notches having a shape generally corresponding to the shape of said handle extensions for close mating engagement therewith, said end plates being welded to the ends of said sleeve and handle extensions to provide a torque box over the entire length of said handle.

2. The racket of claim 1 wherein there is a slight clearance between said handle extensions and metal sleeve at the inner end of said handle in the region of said notches which is completely filled with weld metal.

3. The racket of claim 1 wherein said handle extensions terminate adjacent the inner face of said end plate at the outer end of said handle, said notches in said last-mentioned end plate being in alignment with the ends of said handle extensions and completely filled with weld metal for attaching said last-mentioned end plate to said extensions.

4. The racket of claim 1 wherein said handle extensions are tapered toward their outer ends within said handle to reduce the weight of said frame.

5. The racket of claim 1 wherein said bow is provided with a plurality of circumferentially spaced holes therethrough for the strings, the ends of said holes being coined to provide smooth, rounded shoulders to protect the strings against damage by sharp corners.

6. The racket of claim 5 further comprising a first bridging element welded between the ends of said central region, said first bridging element having string holes therein with coined ends providing rounded shoulders for protecting the strings against damage, the holes through the outer ends of said first bridging element being disposed at an angle to clear the weld connections between said first bridging element and bow.

7. The racket of claim 1 wherein said frame and handle are made of aluminum, welded together and heat treated to comprise a completely unitized all metal racket.

8. The racket of claim 7 wherein said metal frame is an extrusion having a groove extending completely around the outer periphery of said bow, said groove being intersected by said holes for receipt of the portions of the strings between said holes to protect the same against damage by external forces.

9. The racket of claim 1 wherein said frame is in the form of an extruded strip of metal having a generally elliptical cross section to provide a true aerodynamic shape in the direction of ball stride for maximum efficiency and minimum air resistance.

10. The racket of claim 9 wherein said frame has a groove which extends around the entire inner periphery of said frame and longitudinal holes therein for reducing the weight of the racket.

PLAINTIFF'S EXHIBIT No. 12

April 23, 1963 J. R. LACOSTE 3,086,777

RACKET FOR LAWN-TENNIS AND SIMILAR GAMES

Filed March 20, 1961 3 Sheets-Sheet 1

Fig. 1

Fig. 4

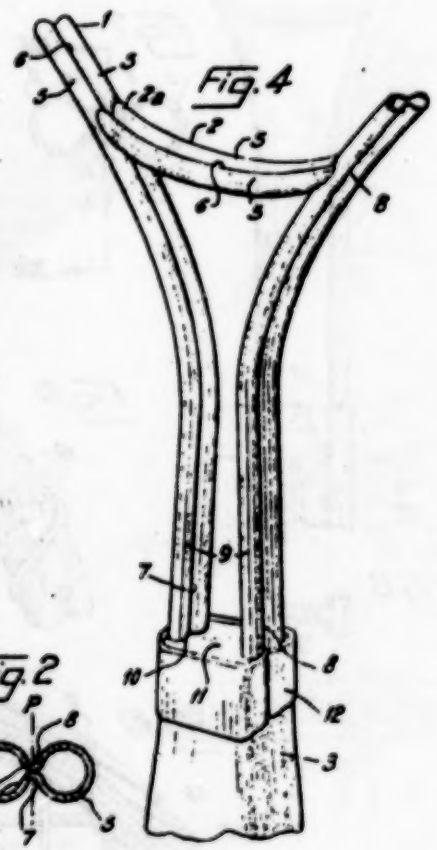
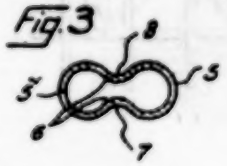


Fig. 2

Fig. 3



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RACKET FOR LAWN-TENNIS AND SIMILAR GAMES

Filed March 20, 1961 3 Sheets-Sheet 2

Fig. 5

Fig. 7

Fig. 8

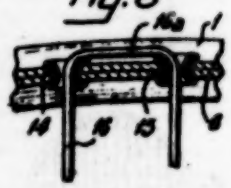
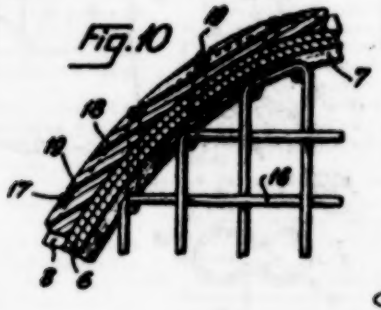


Fig. 9

Fig. 6

Fig. 10



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RACKET FOR LAWN-TENNIS AND SIMILAR GAMES

Filed March 20, 1961 3 Sheets-Sheet 3

Fig. 11

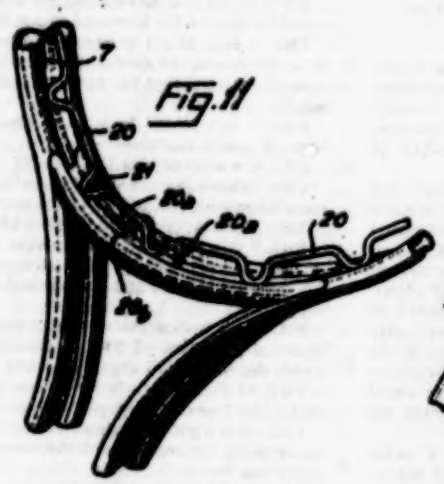

Fig. 12

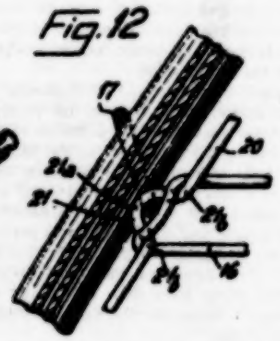

Fig. 14

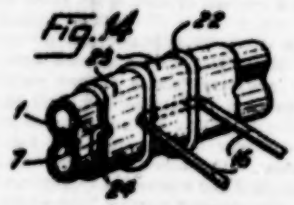

Fig. 13

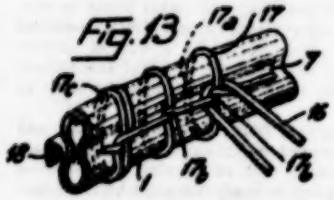

Fig. 15

Fig. 16

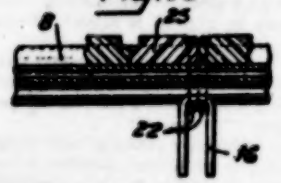

Fig. 17

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RACKET FOR LAWN-TENNIS AND SIMILAR GAMES

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Claims priority, application France Mar. 30, 1960
8 Claims. (Cl. 273—73)

In the construction of rackets for lawn-tennis and similar games, it has previously been suggested to construct the racket frames from metal channel elements or metal tubing of round or oval cross section in place of the conventional wooden frames. However, known rackets of this kind have not been successful.

A satisfactory tennis racket should be lightweight and well balanced. Its frame, while being as far as possible stream-lined in contour parallel to the direction of racket movement when striking a ball, should at the same time possess high resistance to twisting and warping stresses as may arise when a ball strikes the racket off center. Further, it is necessary that the strings be attached to the frame through simple and effective means, preferably with a conventional stringing machine; nor should the strings engage any sharp angles on the frame surface or be subjected to sharp bends since their service life would otherwise be reduced. Moreover the racket should not vibrate or be noisy in use.

It is an object of this invention to provide a racket which will fulfill the above requirements to a high degree.

According to this invention, the racket frame is constructed from a sectional metal element which comprises two spaced beads interconnected by a web of smaller transverse dimension so as to define a pair of longitudinal grooves between the beads along the opposite sides of the element.

Preferably the metallic frame element is tubular; and one convenient method of producing such a tubular frame element is to deform a tube of circular or oval cross section by exerting pressure along two diametrically opposite generatrices thereof; such deforming pressure may be applied far enough to cause the opposite wall surfaces of the tube to engage each other, or alternatively a predetermined spacing may be allowed to remain between said opposite wall surfaces.

In making a racket frame from such a sectional metal element, the element is bent in such a place that the aforementioned beads project from opposite sides of the general plane of the frame.

A racket frame thus constructed combines light weight and strength. Its rigidity in the striking direction is very high even when provided with a low thickness dimension in said direction, so that the drag characteristic of the racket is low.

Such a racket frame can be assembled with a handle made of metal, wood or other material, and such assembly can readily be effected in such a way as to impart excellent resistance against torsional deformations to the racket as a whole.

The stringing of such a racket can be carried out in various ways. Thus the conventional method of threading the strings through spaced holes formed in the frame member may be used, such holes in this case being formed through the web portion of the frame member. Alternatively auxiliary means of attachment may be used for connecting the strings with the frame and in this respect the provision of the outer and inner longitudinal grooves in the frame considerably facilitates the positioning of strings and exerts both a guiding and a protecting function therefor.

The ensuing disclosure made with reference to the

accompanying drawings, given by way of example but not of limitation, will provide a clear understanding of the manner in which the invention may be embodied in practice.

FIG. 1 is a simplified view of an improved tennis racket in front elevation;

FIGS. 2 and 3 show two alternative forms for the sectional contour of the improved racket frame member;

FIG. 4 is a partial perspective view, on an enlarged scale, illustrating the core of the racket and showing one example of the means for connecting the frame with the handle;

FIG. 5 is a partial front view illustrating a modified form of handle assembly;

FIG. 6 is a section on line VI—VI of FIG. 5;

FIG. 7 shows in cross section a perforated racket frame member provided with eyelets for string attachment;

FIG. 8 is a section on line VIII—VIII of FIG. 7;

FIG. 9 is a fragmentary perspective view of a portion of the frame provided with a stringing jig or template for defining the pitch of a helix or coil used in the stringing process;

FIG. 10 is a sectional view on a plane parallel to the plane of projection of FIG. 9 showing the manner in which the strings are engaged around the coil;

FIG. 11 illustrates a serrated wire annulus positioned within the frame for string attachment;

FIG. 12 is a partial longitudinal section showing means for retaining the annulus with the strings attached thereto within the frame;

FIG. 13 is a perspective view illustrating some modified methods of winding the string attaching wire; and

FIGS. 14 to 17 illustrate various ways of mounting the strings on rings threaded around the frame member.

Shown in FIG. 1 is a tennis racket wherein the frame is constructed from a sectional member 1 of special configuration to be described, bent to the requisite shape of a loop, and further provided in this example with an arcuate bracing segment 2 for completing the oval frame. The frame thus constructed is connected to a handle 3 and is provided with strings 4 stretched across it.

The sectional member from which the frame is formed includes two longitudinal beads 5 of preferably rounded form and interconnected by a web portion 6 of lesser thickness so as to define a pair of grooves 7 and 8 on either side of the member. Preferably the member is tubular. It can readily be formed to the desired cross sectional contour by using a tube of any suitable e.g. circular or oval cross section and deforming it by applying pressure along two opposed generatrices of it, e.g. by passing the tubular member through the nip between two rollers of corresponding contour, in one or more passes.

The width and depth dimensions of the grooves 7 and 8 may be varied according to requirements. When using a tubular member as indicated above, the sectional shaping operation may be so effected as to bring the opposite wall portions of the member into engagement in the web portion, as shown in FIG. 2; alternatively a space may be left between said wall portions as shown in FIG. 3.

In forming the frame, the contoured member is bent in such a plane that the beads 5 will be positioned, on opposite sides from the general mid-plane of the frame, the trace of which mid-plane on the plane of FIG. 2 is shown by the dotted line P.

The brace member 3 consists of a length of the same (or a similar) contoured member as that from which the main part of the frame is made. This brace is firmly secured to the main frame part preferably by welding or brazing. Its positioning and assembly are greatly simplified since, as shown in FIG. 4, with the ends 2a cut so as to conform with the shape of the contoured member 1,

the respective bead portions in the main frame member and the brace will provide dual guiding means to permit highly accurate relative centering.

A racket frame constructed as thus described has excellent rigidity in the direction of movement when hitting a ball, while being contoured in said direction for minimum air resistance or drag, and at the same time showing satisfactory resiliency in the direction of the plane defined by the strings. These features are due to the fact that the cross sectional contour of the frame member according to the invention possesses a high moment of inertia referred to the trace of plan P while having a relatively small thickness dimension parallel to that plane.

Tests carried out with racket frames of this type made from hardened alloy steel provided with a hard chromium plating have yielded especially satisfactory results.

The frame may be connected with the handle in any of various ways. Excellent assemblies have been obtained by providing the racket frame with adjacent spaced extensions 9 of the contoured frame member 1 as shown e.g. in FIGS. 1, 4 and 5, and inserting the end portions of such extensions into slots 10 formed in a core member 11 made of wood or the like, then radially reinforcing the assembly by inserting it into an annular ferrule member 12; the ring or ferrule member 12 may, if desired, form an integral part of a tubular handle 3 (FIG. 4). The recesses 10 and the appropriate faces of the ring member may be shaped to conform with the contour of the frame member including the grooves 7 and 8 thereof; however a very strong assembly is found to be obtained even when the recesses 10 and ring member 12 are so formed as to engage only the bead surfaces of the frame member.

In view of the highly rigid character of extensions 9, it may in many cases be found sufficient merely to insert the core member 11 in between said extensions, and bond it thereto if desired. In this modified form the ferrule member 12 would be dispensed with; furthermore, the core 11 may then form an integral extension of the racket handle.

In another modification, shown in FIGS. 5 and 6, the extensions 9 may be inserted into the suitably shaped end portion 13 of a tubular racket handle 3, and the assembly then being preferably welded or brazed.

Regardless of the particular form of frame-to-handle assembly used, an extremely strong connection therebetween is obtainable. The resulting racket assembly is found in particular to show remarkably high resistance against twisting stresses, an important feature for a tennis racket. Further, a good balancing of the racket assembly can be achieved, since the high rigidity and strength of the sectional element from which is formed the upper portion of the handle adjacent the frame, makes it possible so to construct the assembly that most of the weight of it is located at the frame and at the grip, a feature that is found to improve the effectiveness of the racket.

All the above favourable features are obtainable without any increase in weight. Moreover, this construction provides a convenient method of adjusting the weight of the racket by simply modifying the wall gauge thickness of the metal from which the sectional frame member is formed.

Various methods of stringing the racket are applicable in conjunction with the approved construction described above. Thus the strings may either be connected directly to the frame or through auxiliary attachment means, in various simple and effective ways.

According to FIGS. 7 and 8, the web portion 6 of the member 1 and spacer or brace member 2 are perforated at spaced locations and eyelets 15 having rounded edges are inserted through the perforations 14. In this case both walls of the web portion 6 are preferably contiguous. The strings 16 are passed through the eyelets and it will readily be understood that with this arrangement the strings sustain no sharp bends; moreover the string portions 16a lying alongside the frame are positioned within the grooves 8 and are thus protected from damage e.g. when the outer periphery of the frame strikes or rubs against the surface of a tennis court. If desired, the eyelets may be dispensed with and the holes 14 formed with suitably rounded edges.

Embodiments using intermediate string attaching means will now be described. In FIGS. 9 and 10, the strings 16 are attached to the frame by way of a coil or helix 17 of piano wire or the like, wound about the frame member. This method of stringing the racket also derives considerable benefit from the particular type of frame member used according to the invention.

Firstly, the winding of the coil is facilitated in regard to the fact that the pitch of the coil should, as will be understood, be varied along the length of the frame member in order to achieve the requisite spacing between the strings in the different parts of the frame. This problem of correct pitch variation is solved according to the invention by using during the stringing process, a template 18 contoured so as to be insertable into the outer groove 8 of the frame member, the template being formed along its outer surface with spaced notches 19 adapted to receive the turns of the coil 17. The template may remain in place in the finished racket or may be removed after the stringing operation.

In any case tests have shown that after the coil has been properly wound and tightened about the frame member, provided the coil is made from sufficiently stiff wire, the turns of the coil will not be liable to slip or turn. The coil can be stretched tight without impeding subsequent stringing operations since the inner groove 7 in the frame member provides the necessary clearance for threading the strings 16. Moreover, the strings may be passed around two adjacent turns where required without any tendency to shifting the turns. Furthermore, provided the groove 7 has been suitably dimensioned, the strings will be retained laterally by the beads 5 thereby preventing any warping or shifting of the plane of the strings.

The same general advantages as above are present in cases where the strings are not directly attached to the coil. Thus in the embodiments shown in FIGS. 11 and 12, the strings are attached by way of an annulus 20 made of spring steel or the like, and formed with castellations or serrations 21 suitably spaced in regard to the prescribed spacing of the strings 16.

In this case the coil 17 can be very conveniently wound about the frame member and the annulus 20. For this purpose the annulus 20 is snapped into the inner groove 7 of the frame where it is retained by its inherent elasticity without there being any need to provide separate guiding or retaining means therefor. A template such as 18 (FIGS. 9 and 10) may or not be used in this instance as desired. Desirably the ends 20a of the annulus are bent outwards towards the frame member, one of the outbent ends being preferably inserted into a small anchoring recess 20b formed in the inner side of the frame member.

The coil is threaded through the notches 21a defined in the apices of the serrations. The strings 16 are passed across the bases 21b of the serrations and under the coil as shown in FIG. 12. In this case also the groove 7 provides the necessary clearance for the passing of the strings while the beads act to guide and retain the annulus thereby preventing the strings from shifting and vibrating in use. Such a string assembly is found to possess an especially desirable elasticity owing to the elasticity of the annulus 20.

FIG. 13 illustrates some modified means of attaching the coil 17 to the frame member 1. In this case the coil wire is so wound as to present crossed loops 17a to provide half-hitches as at 17b. The strings 16 are passed over the half-hitches and are thereby retained at the requisite spacings while preventing sharp bends in the string. The strings are retained in position by the

beads 5 of the frame. The spacing between the spans of string 16 may if desired be increased by providing the half-hitch with a round turn as shown at 17c. A template 18 is desirably provided in the outer groove 8 of the frame member.

In accordance with a further form shown in FIG. 14 spaced rings 22 may be provided around the frame member for attaching the strings to the frame. As shown in FIG. 14 the rings 22, e.g. metallic and of round cross section, are retained in the requisite spaced relation by means of tubular spacers 23 of appropriately selected lengths and formed with notches 24 to provide clearance for the strings 16. The strings are guided in the groove 7 which moreover enables the strings to be threaded through the rings without having to impart an intricate shape to the rings. Where desired the strings may be passed round one or more spaced rings.

In FIGS. 15 and 16 the tubular spacer 23 are omitted and castellated spacer strips 25 received in the outer groove 8 of the frame member are used instead.

According to FIG. 17 the ring 26 is formed with an inward projection or boss 27 in its side positioned outwardly of the racket which boss engages into the outer groove 8 of the frame member. The string 16 is retained in and guided by groove 7.

The rings 26 may be spaced by means of spacers in the form of spots 28 of solder or plastic resin (e.g. Araldite) deposited within the groove 8 between the bosses of the rings to maintain the prescribed spacings between them.

Various other modifications and alternative will occur to those familiar with the art within the scope of the present invention. In the claims the term tennis racket should be construed in a broad sense so as to include rackets for games other than lawn-tennis, e.g. squash and badminton.

What I claim is:

1. A tennis racket comprising a frame shaped from a frame member of uniform cross sectional contour including a pair of spaced bead portions projecting from opposite sides of the racket frame and an interconnecting web portion defining a pair of longitudinal grooves respectively extending along the inner and outer peripheries of the frame; spacer means located within the outer one of said grooves and providing gaps at predetermined spacings along the outer periphery of the frame; string attachment means providing a plurality of loops passing around said frame member and within said gaps; strings engaging said loops and strung across the frame, portions of said strings extending into the inner said groove and a handle connected to said frame.

2. A racket as claimed in claim 1, wherein said string attachment means comprise a wire coiled around said frame members and having turns engaging said gaps.

3. A racket as claimed in claim 1 wherein said string attachment means comprise a wire wound around said frame member into loops providing half-hitches and respectively engaging said gaps, said strings being passed over said half-hitches.

4. A racket as claimed in claim 1 wherein said spacer means comprise an arcuate template strip member having one edge inserted in said outer one of said grooves and provided in its outwardly directed surface with notches defining said gaps.

5. A racket as claimed in claim 1 wherein said string attachment means comprise rings surrounding the frame member and engaging said gaps.

6. A racket as claimed in claim 5 wherein said spacer means comprise spacer members positioned in said outer one of said grooves intermediate said rings and provided at their ends with notches wherein said rings engage.

7. A racket as claimed in claim 5 wherein said rings are provided with a projection engaging said outer one of said grooves.

8. A racket as claimed in claim 7 wherein said spacer means comprise spots deposited within said groove intermediate said projections of said rings.

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STENOGRAPHIC TRANSCRIPT OF TRIAL

• • •

[4-116] LEWIS L. WARNER, *Sworn*

Direct Examination by Mr. Russell

• • •

[4-128] Q. Now, Mr. Warner, I'd like you to go through the book, further on in the book and look at the patented shapes that are discussed in the patents following. First, let's get where they start. A. M is the first one.

Q. Excuse me. Isn't that L? A. I'm sorry. That is L. L is a Glenn patent.

Q. Can you state for the Court whether there would be any problem extruding a shape of that sort? A. No, sir. No problem.

Q. How about N? And go through these quickly. A. M is Holmstrom. One shape is a triple hollow and one is a Five-Hollow, and that could be extruded very simply.

N is Bijl. Looks like a double hollow which can be extruded. We have extruded similar shapes.

O is Barrett. These are actually solid extrusions which are joined together as a linear structural member and we can extrude those.

P is Dalton. Also double and triple hollows for tripods. We do extrude those types of shapes.

Q is Knox, diving board. It's a multiple hollow. And those shapes can be extruded.

R is Cudini, which represents panel construction, various hollow shapes, which we can and do extrude.

[4-129] S is Mussel. Also hollow shape, which is used in the metal construction field, and we can extrude that type of shape.

T is LaCoste. That's a hollow construction. We can extrude shapes similar to that.

U is also LaCoste. Same thing, hollow shape which we extrude.

V is Chell. Prefabricated wall construction, various hollow shapes which we can extrude and do.

W is Palmer. Various configurations which we can extrude and do.

X is Bruckl. Various tubular shapes, single and double hollows which we can extrude.

Q. Thank You. I show you, Mr. Warner, Patent No. 3,540,728.

Mr. Russell: Perhaps you could hand a copy of Exhibit 7 to the Court. The Court already has it. It's under Tab W in the book we were just looking at.

Q. Ask you if you have read that patent, sir? A. Yes, I have.

Q. If Mr. Palmer had walked into your office in November of 1967, would you have told him you could make that shape? A. Yes, sir.

Q. How about the Figures 6 and 7 with the hollows in them? A. Definitely.

[4-130] Q. Can I ask you what you would have done if he had said, "I'd like to make it even lighter?"

I'll call your attention, Mr. Warner, to Column 1, Lines 28 to 30, where the patent says:

Variations in the weight of the racket must also be possible without substantially affecting its strength to permit use by men, women or children.

And further to Column 3, where it says:

A medium weight racket and a lady's racket may be obtained by using extruded shapes, Figures 7 or 8, with holes therein and perhaps additional groove 42 which also imparts greater flexibility to the frame.

And further down it says:

From the above discussion, it can be seen that the various features disclosed herein permit manufacturing a tennis racket out of extruded metals, preferably aluminum, which

may be on any desired weight and strung in conventional manner without fear of damaging the strings.

Now, Mr. Warner, with that disclosure in Mr. Palmer's patent and Mr. Palmer saying to you, "I'd like to make it even lighter than the one I have shown in the figures," what would you do?

Mr. Lahive: I will object, your Honor.

The Court: He may have it. Answer.

A. Well, what I would do is, if you look at Figure 8, which [4-131] is the double hollow, well, actually, Figure 7 is a double hollow, and it has a groove on the right side of it. So the obvious way to lighten it would be to put a groove on the left side, which is what Palmer did.

Now if you wanted to lighten it any further, you would have several options. One would be to make the holes larger, take away some metal.

The second option would be to make the center web thinner.

I would say, generally speaking, if I had the knowledge of exactly what the person was trying to accomplish, I believe that we could assist in designing an extrusion which would meet that specification.

That's something we do all the time.

Q. Now pegging a date to it, you mentioned that you would like the holes larger, for instance, would that have been in the knowledge of those generally skilled in this art as of 1967?

Mr. Lahive: I object.

The Court: Go ahead. Answer.

A. I would have known that in 1952.

Q. Thank you. That answer is not really my question.

My question was: From your experience around the industry what had been known to others, not just to [4-132] you. A. Oh, yes. I'd say that that knowledge — anyone in the extrusion business would know how to lighten up a

section of this type. It's certainly no special knowledge required for anybody in our industry. I'd say it's a very typical problem.

Q. I show you a copy of the patent in suit, Mr. Warner, and ask you if you have —

The Court: Do I understand that your testimony would be then that it isn't much of a step to go from a Bi-Hollow to a Tri-Hollow?

The Witness: That's correct.

The Court: Okay.

Q. But carrying that forward, Mr. Warner —

The Court: And wouldn't have been in 1967?

The Witness: Your Honor?

The Court: And it would not have been in 1967 much of a step to go from a Bi-Hollow to a Tri-Hollow?

The Witness: This really is sort of basic extrusion design.

The Court: Try to answer my question. It wouldn't have been much of a step in 1967 to go from a Bi-Hollow to a Tri-Hollow?

The Witness: That's correct.

Q. And carrying that further, it wouldn't have been much of [4-133] a step or any step of any consequence to take the hollow of Palmer in Figures 7 and 8 and make them bigger? A. That's correct.

The Court: Specifically, was it much of a step to go from Exhibit MM for Identification to NN for Identification?

The Witness: One is — my eyesight is not that good.

One is a double hollow and one is a triple, as I recall.

The Court: You take a good look at it.

The Witness: The question was: Would it be much of a step to go from this to this?

Q. From the red to the white. A. My answer it: It would not be much of a step at all.

The Court: In 1967 or now?

The Witness: In 1967 or now or prior to 1967.

The Court: Okay. Thank you.

Q. And that is in terms of being your ability to extrude it, isn't it? A. Yes, sir.

Q. Do you know what the influence on change of torsional resistance would be by taking out that portion in the hollow? [4-134] A. I think here you get into some questions. If you move the metal away from the center axis, you would achieve greater strength as a general rule.

And by taking metal out of the center, making the shape slightly larger, you also increase the strength of the shape.

Q. So in order to increase the strength, you have to take it out from there and put it somewhere else? You can't just take it out? A. Well, just removing metal is not going to increase strength.

Q. You have to take it out, put it somewhere else? A. The basic concept of increasing the strength of a hollow is the relationship of where the metal is versus the center of gravity.

Q. So if you take it out and you put it as far away as possible, is that correct? A. The further away that you put the metal, the stronger the section from the center of gravity.

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[6-73] JAMES M. LONG, *Sworn*

Direct Examination by Mr. Russell

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[6-81] Q. Mr. Long, I will show you an exhibit, Plaintiffs' Exhibit 36, and ask you if you can identify or if you recognize that exhibit? A. Yes, I do.

Q. Will you state for the Court what it represents? A. Well, it shows the cross-sectional areas of a number of different extrusions that have been involved, starting with Wilson and for, I guess, comparison reasons, and showing original, and then the first Spalding, which is labeled No. 3, and then Spalding first medium, which is labeled "No. 4," and Spalding second medium, which is labeled "No. 5," and Spalding third medium, with the words "String Protection, No. 5A."

It has certain dimensions on each one of the cross-sections.

Q. Now, will you state for the Court whether or not the item on there, entitled, "Original Sullivan," was an acceptable cross-section? A. No. This was the cross-section that we started with and it failed in our whack test immediately.

The Court: This is before it got to you? Are you talking about the whack test you heard about or are you talking about subsequent?

The Witness: No, the whack test I heard [6-82] about was something that the rackets, I guess, were made outside of our plant by somebody.

The Court: I see.

The Witness: As soon as we got involved, our project was to pick it up and spec it out get it into production.

So, we started with the original extrusion. We started with this extrusion. We were involved in getting dies for the extrusion work and the whole job.

The first thing we did was make extrusions — one of the

first things — and then make some rackets and whack the rackets and test the rackets, and in that initial work the racket failed.

I think one other major point was that, at that point, the racket, as it came to us, was in this configuration, and it also included a plastic strip.

Q. Excuse me, Mr. Long.

Mr. Kenway: Let him finish his answer.

The Witness: That was the only racket I was trying to identify in response.

Q. The only thing I was going to say was that "this" on the record means nothing. Would you identify the figure on the drawing you are looking at so that the record will be meaningful? [6-83] A. Well, I am looking at the one marked "original." It is the second drawing from the left.

Q. On Exhibit 36? A. It is marked "original."

The Court: What exhibit?

Mr. Russell: 36.

The Court: Walter, do you have 36, please?

The Clerk: Yes.

The Witness: It is marked "Exhibit 36." It is the configuration marked "original."

Q. Now, would you continue, please. You were talking about making whack tests on that cross-section and you stated that it failed. A. Yes. As I recall, in fabricating the racket, there was some difficulty to get the proper outline, the proper pole shape. The extrusion itself was subject to moving or bending or losing its shape and it was such a 'radical failure" — I think that is the right way to state it — that it was immediately obvious that immediate correction was needed and that was to beef up the cross-section, and, therefore, using just a common-sense rule, we immediately expanded the periphery in every direction — in both directions — and came up with the cross-section that is shown here, marked No. 3, which is the third from

the left, [6-84] and we proceeded to make Smasher frames on that extrusion.

Q. Was that successful? A. It passed the whack test and it stood up a little better in stringing and we approved it and we went with that cross-section. However, when it got into the field, we continued to have problems with it. We had a fair amount of problems with bending and we had a considerable amount of trouble with it going out of shape.

Q. So then what did you do? A. Well, it was later improved. I left before it really got improved. I left when it was still in that condition. I left the job.

Q. Were you aware at a later date of the extrusion which is called the "5A"? A. Yes.

Q. Are you in a position to state for the Court whether or not the differences were major or minor? Is there some way to characterize the differences between the original and the 5A? A. Well, I would consider them major because the end result was considerably better than with the No. 3, No. 3 extrusion. They were moves in the same general direction, though, that we had taken to go from the [6-85] original to the No. 3.

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[6-103] EGON RAHMACHER, *Sworn*

Direct Examination by Mr. Russell

Q. Will you state your full name? A. Egon Rahmacher.

Q. And where do you live? A. 1383 Northampton Street, Holyoke, Mass.

Q. Will you give us briefly your educational background and employment record? A. I was born and brought up in Germany and went to the Institute of Technology in Zurick. I came over to this country in 1956 and joined Spalding the same year, 1956.

I left Spalding for a period of three years, but I am back with Spalding since 1967.

[6-104] Were you involved with tennis rackets during these years? A. On and off, yes, I have.

Q. Did you ever meet Messrs. Latham and Brefka? A. Yes, I have, in 1968.

Q. Will you state your connection with them and their project involved in this patent suit? A. I recall when Paul Sullivan came in with the original racket and showed it to us.

Q. And did you conduct a whack test of that? A. I was requested to have the physical testing department test this racket, whack test it.

Q. And how did it come out? A. It failed the whack test.

Q. Mr. Rahmacher, I show you Plaintiff's Exhibit 74 and I would like you to explain why it indicates on Page 1 that there was a permanent deformation of 31/64 inch and on Page 2 it looks like 3/16 — a 12/64 difference, can you reconcile it for the Court? A. Yes. Those are two different dimensions.

The one stated in the first page is when, if I may, when you put this tennis racket (indicating) —

Q. For the record, I have given the witness a racket. A.

(Continuing) — straight down, and the dimensional reflection is taken here, this dimension here, underneath [6-105] the very tip of the bow.

Q. The witness is pointing to the end of the racket. That's the dimension on Page 1? A. Yes.

And on the following page where it refers to 3/16, you put it down this way, and in this area here — two different dimensions.

Q. Two different dimensions? A. But normally we refer to the whack test deformation in this area. (Indicating.)

The Court: You mean at the tip?

The Witness: The very tip of the bow, yes.

Mr. Russell: I would like to offer this as an exhibit, Tripple G.

Mr. Lahive: No objection.

The Court: I take it Tripple G is the racket that was original whack tested, is that it?

Mr. Russell: Not so, your Honor, we don't have that racket.

The Court: What is it?

Mr. Russell: Mr. Rahmacher has deformed this to give an illustration to the Court of what 31/64 inch would be, so you can see for yourself what type deformation took place in the original test.

Q. Would you please identify Exhibit Triple G for the [6-106] Court and indicate what you did to it? A. This is the one I intentionally bent at the request of Mr. Russell to simulate those dimensions given in this exhibit, and I carefully bent it to the exact dimensions as closely as I could, to that dimension.

Mr. Russell: So I can hand this up to the Court as being what your Honor would have to play with if it were bent in accordance with the original racket of Mr. Sullivan.

The Court: It looks like my racket.

(Tennis racket marked Defendant's Exhibit GGG and received in evidence.)

Q. Now, Mr. Rahmacher, moving quickly to Plaintiffs' Exihibt 36 and the various cross-sections across it, will you state for the Court your opinion as to the nature of the differences between the original Sullivan and the 3 and the 5A? A. The basic difference between the 3 and the 5A is that material has been spread away from the neutral section for strength purposes.

Q. Do you have an opinion as to whether or not the original Sullivan on that cross-section on Exhibit 36 was a successful racket?

Mr. Lahive: I object to that, he is not qualified —

[6-107] The Court: I have difficulty with what the term "successful" means.

Mr. Russell: Successful from the point of ability of being able to stand up in the field.

Mr. Lahive: I object.

The Court: Your are talking about the playing aspect?

Mr. Russell: Once Spalding sells it, is it going to be returned.

The Court: Whether it is marketable, is that your question?

Mr. Russell: It might be sold by the Spalding name, but is it predictable that the customers will bring it back for failure?

Mr. Lahive: I object to that as his not having qualifications so far on customer relations or customer reactions at all.

Mr. Russell: Perhaps he is right. I was trying to hurry.

The Court: I don't want you to hurry. I think he is qualified to answer that. He works for Spalding.

What you are asking is whether or not he thinks the original Spalding racket would have held up sufficiently

so it would have been marketable without an [6-108] undue number of returns, is that it?

Mr. Russell: That's precisely it.

Q. Can you answer that? A. To my opinion, it would not.

Q. And what was the experience with No. 3 with respects to returns? A. Our marketing peoples were up in arms about it because it still didn't live up to any good expectations.

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[4-45] PETER A. LATHAM, *Sworn*

Direct Examination by Mr. Russell

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[4-56] Q. Now, Mr. Latham, you heard the testimony of Mr. Brefka and I was questioning him about this sentence in the lower, just below the middle which says: "We rapidly found that a double hollow with an overall height and width of ratio 2 to 1 was required with height reaching 11/16 to 3/4 of an inch half for that width.

Now, I can't recall that he gave me any indication that there were any tests made of rackets other than 2-to-1 ratio — can you elaborate any further on that?

Were there any tests, other tests? A. This statement refers to all the work that we did, so that it pertains to calculations and tests on other solids.

Q. Well, isn't it a fact that the height of the racket which you did have extruded by Minalex didn't even reach 11/16? It was .680. A. Well, I would have to see a chart, I don't remember what .680 is. This was a generalization.

Q. I see.

How about the line at the bottom which was crossed out: No opening where the height was less than [4-57] the width worked." A. Well, apparently I crossed it out because I wasn't happy with the way it was worded.

Q. Did you ever test anything that had a height the same, for instance, as the width of the opening? A. No, we didn't test it.

[4-58] Q. How about the other way around, that the opening was wider than the height? A. No. We didn't actually make tests.

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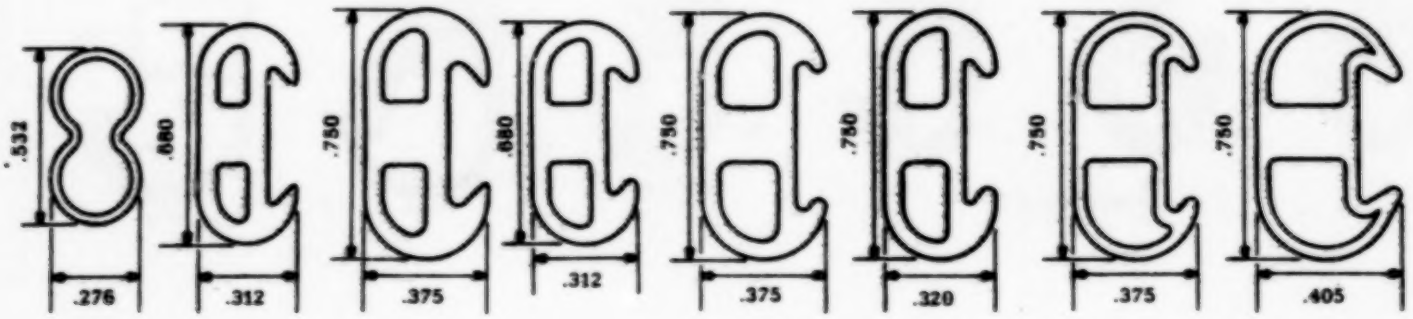
PLAINTIFF'S EXHIBIT 37

WILSON	LDA	LDA	ORIGINAL	SPALDING	SPALDING	SPALDING	SPALDING
STEEL	11-20-67	11-20-67	11-20-67	HEAVY	FIRST MEDIUM	SECOND MEDIUM	THIRD MEDIUM STRING PROTECTION
(PASSED)			(FAILED)	(PASSED)	(FAILED)	(PASSED)	(PASSED)



PLAINTIFF'S EXHIBIT No. 37

DEFENDANT'S EXHIBIT
1-6-75
Ex 55

	Palmer fig. 7	Palmer fig. 8	Latham-Brafka (original)	Latham-Brafka patent in suit	Spalding 5A	Spalding 9A
Relative Stiffness	X axis - +2 % Y axis - +55	+1 % +17 %	+19 % +21 %		+12 % +83 %	+33 % — X axis +105 % — Y axis

DEFENDANT'S EXHIBIT 55

DEFENDANT'S EXHIBIT TT